



OPEN ACCESS

EDITED BY

Ding Li,
Southwestern University of Finance and
Economics, China

REVIEWED BY

Juheon Lee,
Midwestern State University, United States
Minh-Hoang Nguyen,
Phenikaa University, Vietnam
Xing Yan,
Beijing Normal University, China
Zhang Chuanwang,
Liaoning University, China

*CORRESPONDENCE

Chen Wei,
✉ chenboy@mail.hzau.edu.cn

RECEIVED 24 April 2025

ACCEPTED 28 August 2025

PUBLISHED 17 September 2025

CITATION

Hengyi L, Zeyu Z, Zixiang L and Wei C (2025)
Stay or leave? The impact of cities' air quality on
the settlement intention of urban migrants:
empirical evidence from China.
Front. Environ. Sci. 13:1616579.
doi: 10.3389/fenvs.2025.1616579

COPYRIGHT

© 2025 Hengyi, Zeyu, Zixiang and Wei. This is an
open-access article distributed under the terms
of the [Creative Commons Attribution License](#)
(CC BY). The use, distribution or reproduction in
other forums is permitted, provided the original
author(s) and the copyright owner(s) are
credited and that the original publication in this
journal is cited, in accordance with accepted
academic practice. No use, distribution or
reproduction is permitted which does not
comply with these terms.

Stay or leave? The impact of cities' air quality on the settlement intention of urban migrants: empirical evidence from China

Liu Hengyi^{1,2}, Zhang Zeyu^{1,2}, Luo Zixiang¹ and Chen Wei^{1,3*}

¹College of Economics and Management, Huazhong Agricultural University, Wuhan, China, ²Macro Agriculture Research Institute, Huazhong Agricultural University, Wuhan, China, ³College of Public Administration, Zhongnan University of Economics and Law, Wuhan, China

As a widespread environmental problem, the relationship between the air pollution and the intention of urban migrant populations to stay in cities has been discussed more limited at the micro level. We investigate the effects of air pollution on the willingness of migrant population to settle down by Probit model, based on the data from 2017 to 2018 in China Migrants Dynamic Survey (CMDS). The results of the study show that an increase of 100 units in the AQI leads to a significant decrease of approximately 13.25 percentage points in the settlement intention of urban migrants. This effect exhibits notable heterogeneity, with air pollution having a particularly negative impact on males, married groups, middle-aged and elderly people over 50 years old, those engaged in agriculture, forestry, animal husbandry and fishery, and high-income groups. In addition, this paper further examines the mechanism by which air pollution reduces the willingness of migrants to stay, and finds that air pollution affects the settlement intention mainly by reducing health status, labour time and wage income. Moreover, the urban green coverage can mitigate air pollution's negative impact on migrants' settlement intention. Air pollution not only undermines investment in human capital, but may also be an impediment to sustainable urban development. Therefore, this study can provide a new perspective for urban development and human capital accumulation.

KEYWORDS

air pollution, urban migrant, settlement intention, probit model, mechanism analysis

1 Introduction

Air pollution has brought about many problems, such as smog, and has become one of the world's biggest public health challenges (Hanna and Oliva, 2015). Epidemiological and economic studies indicate that outdoor air pollution causes 3.3 million premature deaths per year globally (Neidell, 2009; Ahumada and Iturra, 2021; Zhang et al., 2022), with Asia being the most severely affected. Enhanced environmental monitoring has brought problems such as smog and sandstorms to the forefront of public awareness. Severe air pollution not only places added pressure on residents' daily lives but has also become a major societal concern. As living standards rise, the public awareness of air pollution is also increasing. Firstly, air pollution directly affects people's physical and mental health (Li et al., 2024; Lim et al., 2024), increases residents' healthcare expenditures (Zhang and Mu, 2018; Huang and Lanz, 2018), and also reduces their sense of wellbeing (Levinson, 2012). Second, severe air pollution compromises the safety and quality of production, often reducing

output or even halting operations, thereby hindering economic development (Feng et al., 2023). At a deeper level, chronic air pollution is detrimental to sustainable economic development, reflecting the “eco-deficit” inherent in conventional growth models that prioritize economic expansion over environmental sustainability (Vuong and Nguyen, 2025). This model can lead to “immiserizing growth,” where economic gains are undermined by severe environmental and social costs, such as the erosion of human capital through health deterioration and productivity losses (Vuong, 2021). With the increasing prominence of environmental problems brought about by traditional economic growth methods and the deepening of people’s awareness of healthy living, the migrant population no longer chooses to stay in a place solely on the basis of economic considerations (Li et al., 2023), and environmental factors are gradually being taken into important consideration (Chen et al., 2018). However, previous research on migrants’ location choices has often overlooked environmental factors such as air quality (Xu et al., 2022). Air quality is a core aspect of urban livability, and incorporating it into labor migration studies offers significant theoretical insights into understanding the workforce’s locational behaviors.

This paper explores the association of air pollution and the settlement intention of urban migrants in China, which is also an issue of considerable practical importance. First, China’s labor mobility has expanded markedly with economic development and reforms to the household registration (*hukou*) system. According to data from the 2021 Seventh National Population Census, the migrant population in China has increased by 70% over the past decade (Wu et al., 2022). Second, migrant flows bring human capital into different regions, acting as a vital engine of regional economic growth. By redistributing labor between areas with surplus and shortage, migration improves the overall allocation of labor and enhances efficiency (Sun et al., 2019). Allowing labor to move freely according to market mechanisms promotes balanced regional economic development, laying the groundwork for urban-rural integration and shared prosperity. However, real-world trends show that market-driven labor migration often concentrates workers in economically advanced regions (Shen et al., 2023), leading those areas to approach their population carrying capacity while less developed regions face a shortage of skilled personnel. This imbalance increases social pressures in economically advanced areas, undermines human capital accumulation in less developed regions, widens income gaps, and impedes coordinated urban-rural development. Consequently, understanding the factors that shape labor migration decisions and guiding these flows in a more balanced manner carry significant practical implications for economic growth and regional coordination (Liu et al., 2024b; Shang et al., 2022).

Complicating this dynamic in China is the household registration (*hukou*) system, a fundamental institution shaping migration patterns. In major cities, access to full social welfare, public education, and other local privileges is intrinsically tied to possessing a local *hukou*, which remains restricted for most migrants (Chen et al., 2018). This creates a scenario where migrants may be compelled to tolerate environmental disamenities like air pollution as a necessary trade-off for accessing superior economic opportunities—a phenomenon aligning with the theory of “compensating differentials” (Huang

and Lanz, 2018). Consequently, the settlement intentions of China’s migrants are not merely a function of environmental and economic calculations (Li and Li, 2022) but are also profoundly shaped by these structural constraints. This paper contributes to this discussion by examining settlement intention net of these institutional pressures, focusing on the underlying environmental preferences that would likely be more fully expressed in a less restricted mobility context.

The marginal contributions of this paper, which set it apart from existing research, manifest in three key ways. First, most previous studies on the relationship between air pollution and labor have concentrated on how air pollution affects labor supply, for instance, one of the empirical researches has demonstrated that a 10 $\mu\text{g}/\text{m}^3$ increase in $\text{PM}_{2.5}$ concentration reduces farmers’ daily agricultural labor hours by 0.4 h (Ye et al., 2023). Numerous studies have further confirmed that rising $\text{PM}_{2.5}$ levels exert a negative impact on labor supply duration (Yamada and Narita, 2025; Altansukh et al., 2025). But few studies consider the air quality as a determinant of migrant location decisions. Yet as people’s perceptions of quality of life continue to shift, air quality has become an increasingly critical factor in where migrants choose to settle, underscoring this study’s significant practical value. Second, most existing research adopts a macro perspective, using national-level aggregated data to measure population mobility, such as the number of employed persons used by Xiao (2016), national immigration data used by Fu and Gu (2017) and Xu and Sylwester (2016a), few studies have employed micro-level individual-level data to explore the differing impacts of air pollution on individuals with varying characteristics. Numerous studies have employed machine learning and other related computational methods to predict air quality. For example, Choudhary et al. (2023) and Kumar et al. (2024), both selected India as their study region, employed diverse computational algorithms to project sustained increases in future $\text{PM}_{2.5}$ and hazardous gas concentrations. Their findings further indicate that crop residue burning, wildfire incidents, and elevated aerosol levels will exacerbate $\text{PM}_{2.5}$ accumulation in the region (Kumar et al., 2024). These studies highlight that air quality is an critical societal issue in the future and focus on the factors that influence air quality. However, the most fundamental purpose of environmental governance is sustainable development. Since humans constantly inhale air, public health directly depends on air quality. Continued development of polluting industries will eventually undermine socioeconomic progress. Therefore, integrating environmental and human factors is both essential and practical (Hu et al., 2022; Yue et al., 2024). Both regional surveys and air quality prediction studies fail to systematically integrate air pollution with human behavior and social development. Moreover, their reliance on macro-level data (Li et al., 2021) suffers from data opacity issues, preventing clear identification of population subgroups with varying susceptibility to air pollution. To fill these research gaps, this study uses individual-level microdata to explicitly reveal the heterogeneous effects of air pollution on migrants’ settlement intentions. By leveraging micro-level data, this paper links the air quality and human behavior and provides a clearer portrayal of the heterogeneous effects of air pollution on migrants’ willingness to remain, thereby offering more targeted insights for cities seeking to retain human capital through environmental governance. Finally, few scholars have examined

the mechanisms through which environmental factors drive population migration decisions. By exploring three pathways through which air pollution influences migrants' willingness to stay, this paper enriches the current body of literature in this area.

2 Literature review and research hypotheses

The relationship between environmental issues and population mobility can be traced back to the “stress threshold” theory (Wolpert, 2010). This theory incorporates non-economic factors—such as environmental conditions—into the analytical framework of population mobility, positing that individuals make migration decisions in response to pressures or stress from their current place of residence. From the 1970s to the 1990s, theoretical models like the Harris-Todaro model (Harris, 1970), the stress-threshold residential mobility model (Speare, 1974), and the residential satisfaction-migration model emerged, further integrating non-economic factors into migration research. These developments not only enriched the field but also underscored the influence of environmental factors on migration (Slovic, 1987), marking the initial, albeit slow, phase of environmental migration research. Since the 1990s, research related to environment and population mobility has entered a period of rapid development, and the impact of air pollution on population mobility and migration has received the attention of many scholars (Germani et al., 2021; Xu and Sylwester, 2016b). A growing body of literature documents the relationship between environmental quality and migration, and frequently shows that changes in environmental quality can induce migration (Vilhelmson and Thulin, 2013). Air quality, as the main indicator of environmental pollution, has two effects: a push from the city of origin and a pull from the city of targeted inflow. Then, according to the “Push-Pull Theory” (Lee, 1966), air pollution is often seen as a negative factor in the inflow to the area, which may reduce the willingness of the migrant population to settle in the city.

Since the smog problem of China has been exposed in 2013, air quality has entered the field of domestic research, and the impact of air pollution on labour mobility and migration has attracted the attention of more scholars. Initially, some studies based on regional surveys provided preliminary evidence that air pollution could lead residents to consider moving away. For instance, Wang (2016) conducted a telephone survey in Beijing, and the data showed that environmental issues marked by smog had caused widespread public concern, with some individuals developing migration intention due to such pollution-related worries. Meanwhile, researches also found that improvements in Beijing's air quality can enhance residents' satisfaction with their living environment, thereby increasing their willingness to remain in this city. In addition, more and more quantitative studies used PM_{2.5} concentration as a measure of air quality (Chen et al., 2023) and found a negative relationship between urban PM_{2.5} concentration and residents' settlement intention (Chu et al., 2015; Sun and Sun, 2018; Sun et al., 2019). Firstly, regarding health impacts, numerous studies have demonstrated that air pollution can lead to various acute and chronic diseases, thereby harming both physical and mental wellbeing (Hanna and Oliva,

2015). To avoid deteriorating health conditions, individuals may develop intentions or take actions to relocate (Deschênes et al., 2017). And then, people generally prefer not to work for extended periods in areas with severe air pollution (Masuda et al., 2021). Consequently, they are more inclined to reside in regions with better air quality to ensure sustained labor productivity and secure stable income. Therefore, this paper proposes Research Hypothesis 1:

Hypothesis 1: The air pollution is negatively associated with migrants' settlement intention.

Assuming that Hypothesis 1 holds, we provide more detailed explanation of the possible mechanisms between air pollution and settlement intention. Research on air pollution and residents' health spans multiple disciplines, including medicine and sociology. It is widely recognized that air pollution negatively impacts both physical and mental wellbeing, particularly by causing respiratory diseases (Chay and Greenstone, 2003; Knittel et al., 2016; Neidell, 2004; Tanaka, 2015). Prolonged exposure to contaminated air may increase mortality in infants and the elderly, who are more susceptible to the effects of ambient air pollution (Currie and Neidell, 2005; Jayachandran, 2009). Health, as a core component of human capital, directly influences labor capacity. At the same time, it serves as a vital personal asset. When migrants maintain good health, they tend to have a more positive mindset and greater vitality, enabling full participation in production activities and everyday life. This improved wellbeing enhances their overall satisfaction as residents and increases their intention to settle (Liu and Yu, 2020). Accordingly, this study posits that air pollution likely affects migrants' settlement intention by undermining their health.

Hypothesis 2: Air pollution reduces migrants' settlement intention by negatively affecting their health.

People take various measures to avoid the negative impacts of air pollution on their health status, such as reducing the amount of time they spend working outside (Neidell, 2009). From the perspective of labor supply, prior studies have shown that environmental pollution has a substantial negative effect on labor supply levels (Sheng et al., 2016). In particular, an increase in air pollution—especially rising PM_{2.5} concentrations—leads to a reduction in working hours (Zhao et al., 2021). As environmental awareness grows, the natural environment has become an increasingly significant consideration for labor migration decisions, with pollutant emissions exerting a “push effect” that drives different labor groups away from cities (Xiao, 2016). Labor mobility is most directly reflected in the willingness to settle in a particular location (Li, 2014). If high levels of air pollution reduce labor supply, shorter working hours lead to lower labor income, further fueling migration intentions and consequently diminishing migrants' inclination to remain where they are (Cai, 2018). Therefore, this paper proposes Research Hypothesis 3:

Hypothesis 3: Air pollution reduces migrants' settlement intention by decreasing their working hours and income.

As a negative environmental externality, air pollution adversely affects human health, life quality and social economic (Chang et al., 2024; Liu M. et al., 2024). Consequently, there is currently a

significant amount of research exploring how to improve air quality. Society's governance of the environment includes enacting environmental laws and regulations, implementing pollution taxes (Li and Ramanathan, 2018), and controlling pollution emission rights to encourage companies to invest in pollution control (Zhu, 2015). These policy measures may be effective in protecting the environment. Compared to policy interventions, urban greening represents a more direct mitigation strategy. Vegetation effectively filters airborne pollutants and reduces ambient PM_{2.5} concentrations (Akaraci et al., 2022). As critical ecological infrastructure, urban green spaces can not only directly improve air quality but also mitigate the negative impact of pollution on residents' quality of life. Therefore, this study will further evaluate whether urban green coverage can effectively mitigate the impact of air pollution on residents' settlement intention.

Hypothesis 4: Urban green coverage can mitigate the negative correlation between the air pollution and migrants' settlement intention.

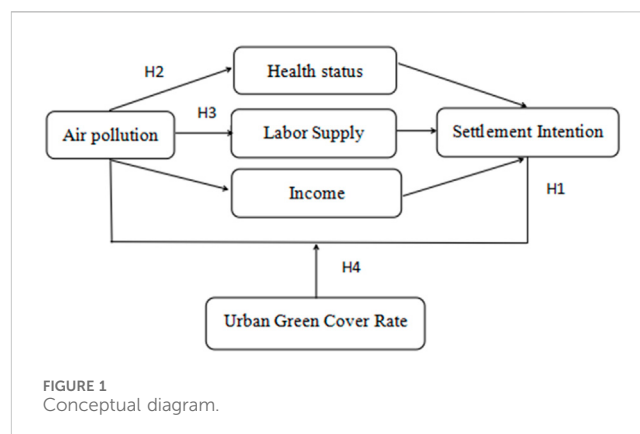
By reviewing the existing literature, we find that environmental factors have garnered substantial scholarly attention in the context of labor mobility. Although previous research has accumulated and evolved over time, several gaps remain. First, most studies examine how air pollution affects labor supply—whether in terms of hours worked or overall labor availability—without considering air quality as a key determinant in migrants' locational choices. Yet as lifestyle perceptions continue to shift, air quality has gradually emerged as an important consideration for migrants deciding where to settle. Second, domestic research on air pollution and population mobility has yet to form a cohesive analytical framework. Most existing studies adopt a macro-level perspective, rarely investigating how air pollution may differentially affect individuals based on distinct characteristics. In response to these limitations, this paper employs both macro- and micro-level datasets for regression analysis, drawing on the relatively mature analytical methods established by earlier studies. We conduct a stepwise test of the stated hypotheses and give particular attention to the relationship between air pollution and migrants' settlement intentions. Through a more comprehensive empirical approach, this study clarifies the mechanisms by which air pollution shapes labor mobility decisions, offering more practical insights for cities seeking to retain human capital through effective environmental management. We use Figure 1 to generalize all the hypotheses.

3 Data and methods

3.1 Data

3.1.1 Air quality

The air quality data were obtained from the China Air Quality Monitoring and Analysis website, which reports the monthly average concentrations of AQI, PM_{2.5}, PM₁₀, NO₂, and other pollutants. While many scholars rely on PM_{2.5} or SO₂ as air quality metrics, focusing on a single pollutant can be too narrow. Consequently, this study adopts the comprehensive Air Quality Index (AQI) as the core explanatory variable. As a composite measure of multiple major pollutants, the AQI produces a single indicator—higher values indicate more severe air pollution. It



should be noted that migrants are unlikely to instantly perceive current air quality and immediately decide whether to remain in a particular location. Recognizing that the effects of air pollution on people's decisions involve a lag, the AQI value for each participant in this study was set to the average AQI of their location during the month prior to the survey. This ensures that every migrant surveyed had at least 1 month of exposure to actual air quality before being interviewed. Since the National Health and Family Planning Commission conducts its national dynamic monitoring survey of the migrant population each May, the air quality data used in this study consist of the average of the April AQI for each survey year.

3.1.2 Migrant population

The migrant population data used in this study were drawn from the 2017 and 2018 China Migrants Dynamic Survey (CMDS), a nationally representative survey conducted by the National Health Commission of China across all provincial-level administrative regions. They focus on the temporary migrants, the individuals aged 15 and above who have resided in their destination city for at least 1 month but do not hold a local household registration (in Chinese we call it "hukou"). Employing a multistage probability proportionate to size sampling design, the survey first selects representative communities before conducting a complete enumeration of migrant residents to collect baseline demographic information. Prior to participation, all respondents were explicitly informed that the survey was for research purposes only, that their information would remain strictly confidential, and that participation was voluntary. The questionnaire consists of several key sections: (1) Basic family and demographic information; (2) Employment, consumption, and income; (3) Access to basic public services; (4) Access to basic medical services; (5) Marriage, fertility status, and family planning service management.

This study focuses on migrants' settlement intention rather than their definitive decision to stay. We adopt the measurement approach developed by Liu and Yu (2020) for this variable, utilizing data exclusively sourced from the China Migrants Dynamic Survey (CMDS) database. In the survey, respondents were asked, "Do you wish to continue living in this location?" Possible answers included "Yes," "No," and "Not Sure." Since "Not Sure" differs fundamentally from both "Yes" and "No" and lacks a clear definition, these responses were excluded from the sample. Among those who answered "Yes," a follow-up question asked how many years they intended to stay. To narrow the analysis to long-term settlers, this study classifies a migrant

as “willing to stay” if they plan to remain in their current location for at least 5 years; anyone unwilling to stay that long is classified as “not willing to stay”.

3.1.3 City characteristic variables

Air pollution may not be the only factor influencing migrants' willingness to stay. A city's development prospects, economic strength, and public service resources also play a critical role in shaping residents' decisions about whether to remain. Consequently, it is necessary to include city-specific characteristics as control variables. The relevant city data in this study come from the China City Statistical Yearbook. Four indicators were selected to represent urban characteristics: total population at year-end, *per capita* GDP, the number of regular higher education institutions, and the number of public libraries. These indicators capture the city's size, economic development level, educational resources, and cultural amenities, respectively, which are important factors in migrants' location choices. The main variable assignment and statistical description are shown in [Table 1](#).

3.2 Estimation strategy

Given that migrants' settlement intention, the dependent variable in this study, is a binary variable, a Probit model was employed for estimation. The model is specified as [Equation 1](#):

$$settle_{i,j} = \alpha_0 + \beta_1 AQI_j + \beta_2 X_i + \beta_3 C_j + \varepsilon_i \quad (1)$$

Where i is the individual and j is the city that the individual is living now. In this context, $settle_{i,j}$ represents the migrant i 's willing in settling down in the destination city j , defined as 1 and 0. According to the questionnaire, if the individual intends to reside locally for 5 years or more, then $settle_{i,j} = 1$; if the individual does not wish to continue living in that location, then $settle_{i,j} = 0$. AQI_j denotes the average AQI in the month preceding the survey for the area where migrant i is located. X_i represents individual characteristic variables, and C_j represents city characteristic variables. Since these variables differ in terms of magnitude, we divide the AQI by 100 before incorporating it into the econometric model for regression analysis. By the same token, we similarly adjust other air quality indicators such as $PM_{2.5}$, PM_{10} , NO_2 , as well as city-level variables such as year-end total population and *per capita* GDP, according to their respective scales.

4 Empirical results and analysis

4.1 Baseline regression results

In this section, we report the baseline regression results of the econometric model. [Table 2](#) presents the results of multiple regressions with different variables included. The results indicate that air pollution has a significantly negative effect on the settlement intention the urban migrants.

Because the coefficients estimated in a Probit model are in terms of probabilities, our main focus is on their marginal effects. [Table 3](#) reports these marginal effects. The findings indicate that air pollution negatively influences migrants' settlement intentions, with statistical significance at the 1% level. The average marginal

effect is -0.0595 , suggesting that, all else being equal, a 100-unit increase in AQI is associated with a 5.95 percentage point reduction in the likelihood of migrants choosing to stay.

In practice, the factors shaping migrants' location decisions are multifaceted. People often consider multiple factors simultaneously, making omitted variable bias unavoidable. There may be unobservable influences that affect both a city's air quality and migrants' propensity to remain. Moreover, urban air quality is heavily influenced by infrastructure and economic development. For instance, cities with intensive industrial activity and high population density often experience more pronounced air pollution, which can lead to reverse causality in the analysis. Given these considerations, addressing the issue of endogeneity becomes essential. To resolve this, the study employs each city's temperature inversion data as an instrumental variable. Under normal conditions, atmospheric temperature decreases with altitude, allowing vertical convection to disperse pollutants from lower layers of the atmosphere to higher altitudes or distant regions, thereby mitigating urban air pollution. However, during a temperature inversion, when atmospheric temperature increases with altitude, this convection is inhibited, causing pollutants to accumulate and intensify air pollution. Because temperature inversion is a climatic phenomenon determined by atmospheric and natural conditions—unrelated to population mobility—it satisfies the exogeneity requirement. After incorporating this instrumental variable, the results indicate that, all else being equal, a 100-unit increase in AQI reduces migrants' likelihood of staying by 13.25 percentage points. This outcome closely aligns with [Liu and Yu \(2020\)](#), who found a 15.1% reduction.

From the perspective of individual characteristics, settlement intention can be influenced by factors such as education level, gender, marital status, and age. For instance, regarding gender, men generally exhibit greater sensitivity to air pollution than women. Traditional societal norms often emphasize “men working outside the home and women working inside,” and women typically marry at a younger age. Consequently, women tend to settle down more easily in one location, concentrating on family life. Larger families, in turn, have a stronger willingness to stay, as the cost of relocating an entire household is higher. Thus, women are less likely to move to another city solely due to air pollution. Regarding city-level characteristics, higher *per capita* GDP tends to increase individuals' likelihood of remaining. Similarly, the presence of more higher education institutions and public libraries often boosts migrants' settlement intentions, indicating that economic development and public service facilities remain critical considerations when choosing where to live. For many, the prospect of better employment opportunities, higher wages, and improved educational resources for their children can offset the negative influence of air pollution.

4.2 Robustness tests

4.2.1 Robustness tests based on air pollution indicators

In all of the aforementioned analyses, we have consistently relied on the composite Air Quality Index (AQI) as the sole measure of air pollution. In practice, however, there are numerous well-known air quality indicators, many of which have been widely adopted in academic research. Therefore, this paper compiles data on four

TABLE 1 Variables description.

Variables	Description	Observations	Mean	Standard deviation	Min	Max
A. Dependent variable						
Settle	1 = Willing, 0 = Unwilling	121642	0.693	0.461	0	1
B. Independent variable						
AQI	Air quality index of destination city	121642	40.52	15.53	3	66
C. Individuals variable						
Family Size	Family members Number	121642	3.143	1.152	1	10
Gender	Female = 0, Male = 1	121642	0.580	0.494	0	1
Education	No Education = 1, Primary School = 2, Junior High = 3, High School/Technical School = 4, College Diploma = 5, Bachelor's Degree = 6, Graduate School = 7	121642	3.646	1.188	1	7
Expenditure	Monthly Household Expenditure (¥)	121642	1,626	2,337	0	10,000
Income	Monthly Household Income (¥)	121642	7,787	5,055	1800	30,000
Working Hours	Average Weekly Working Hours	121642	56.82	18.69	0	120
Age	Age of the respondent in years	121642	36.10	9.600	15	84
Year	Years of Migration	121642	6.443	5.926	0	26
Insurance	1 = Yes; 0 = No	121642	0.0612	0.240	0	1
Marriage	1 = Married, 0 = Unmarried	121642	0.827	0.378	0	1
D. City characteristics						
Population	Total Population at Year-End (10,000)	121642	677.1	530.6	54	3,390
Per_GDP	Per Capita GDP (10,000 ¥)	121642	8.783	6.029	0	23.946
School	Number of General Higher Education Institution	121642	29.18	26.19	1	92
Book	Number of Public Libraries	121642	362.5	516.3	4	2,522
Green	Urban Green Coverage rate	121642	0.394	0.097	0	0.938

Data Source: The data was compiled by the author based on air quality measurement indicators, migrant population data, and city characteristics variables.

TABLE 2 Baseline regression results.

Variables	(1)	(2)	(3)	(4)
AQI/100	−0.231***	−0.0622**	−0.3749***	−0.1948***
	(0.0243)	(0.0261)	(0.0259)	(0.0275)
Education		0.2510***		0.2402***
		(0.0038)		(0.0039)
Family		0.1299***		0.1354***
		(0.0036)		(0.0036)
Gender		−0.0595***		−0.0543***
		(0.0082)		(0.0082)
Marriage		0.1032***		0.1046***
		(0.0065)		(0.0065)
Flow range		−0.5165***		−0.5506***
		(0.0081)		(0.0085)
Age		0.0043***		0.0042***
		(0.0005)		(0.0005)
Insurance		0.2029***		0.2182***
		(0.0178)		(0.0179)
Year		0.0628***		0.0622***
		(0.0008)		(0.0008)
Population			−0.0123***	−0.0078***
			(0.0010)	(0.0010)
Per_GDP			−0.0039***	0.0054***
			(0.0008)	(0.0009)
School			0.4641***	0.2503***
			(0.0241)	(0.0260)
Book			0.0096***	0.0127***
			(0.0008)	(0.0009)
Con	0.599***	−1.2210***	0.6065***	−1.2387***
	(0.0106)	(0.0300)	(0.0119)	(0.0304)
Observations	121642	121642	121642	121642

***, **, *represent significance levels of 1%, 5%, and 10%, respectively; robust standard errors of the regression coefficients are reported in parentheses.

commonly used air pollution metrics—PM_{2.5}, PM₁₀, NO₂, and CO—and substitutes them into the regression model in place of the core explanatory variable (AQI).

The results in Table 4 show that, the regardless of the air quality indicator used, all regressions yield significantly negative coefficients. This confirms that air pollution has a detrimental impact on the willingness of the migrant population to settle, and the findings are robust. Specifically, individuals seem to be more sensitive to PM_{2.5} and NO₂. For PM₁₀ and CO, a 100-unit increase corresponds to a decrease of approximately 5.11 percentage points and 3.37 percentage points, respectively, in the willingness of the migrant population to settle. Overall, replacing the AQI with

various air quality indicators yields consistent regression results across models, aligning with our expectations. That is, holding other factors constant, air pollution negatively affects the willingness of the migrant population to settle, and this effect remains significant at the 1% level, confirming the robustness of our findings.

4.2.2 Robustness tests based on air quality monitoring period

In the previous analysis, all air pollution indicators were based on the average values from the month preceding the survey. However, 1 month may not provide sufficient time for individuals to perceive the impact of air pollution and adjust

TABLE 3 Marginal effects.

Variables	(1)	(2)	(3)	(4)	lvprobit
AQI/100	−0.0812***	−0.0191**	−0.1309***	−0.0595***	−0.1325**
	(0.00854)	(0.0080)	(0.0090)	(0.0084)	(0.0531)
Education		0.0771***		0.0733***	0.0825***
		(0.0011)		(0.0011)	(0.0013)
Family		0.0399***		0.0413***	0.0466***
		(0.0011)		(0.0011)	(0.0013)
Gender		−0.0183***		−0.0166***	−0.0187***
		(0.0025)		(0.0025)	(0.0028)
Marriage		0.0317***		0.0319***	0.0369***
		(0.0020)		(0.0020)	(0.0022)
Flow range		−0.1586***		−0.1680***	−0.1806***
		(0.0024)		(0.0025)	(0.0031)
Age		0.0013***		0.0013***	0.0014***
		(0.0001)		(0.0001)	(0.0002)
Insurance		0.0623***		0.0666***	0.0684***
		(0.0055)		(0.0055)	(0.0054)
Year		0.0193***		0.0190***	0.0209***
		(0.0002)		(0.0002)	(0.0003)
Population			−0.0043***	−0.0024***	−0.0024***
			(0.0003)	(0.0003)	(0.0003)
Per_GDP			−0.0013***	0.0016***	0.0017***
			(0.0003)	(0.0003)	(0.0003)
School			0.1621***	0.0764***	0.0953***
			(0.0084)	(0.0079)	(0.0120)
Book			0.0033***	0.0039***	0.0042***
			(0.0003)	(0.0003)	(0.0003)
Observations	121642	121642	121642	121642	121642

their willingness to settle accordingly. To address this, we use the average AQI values from 2 years prior to the survey year as the core explanatory variable in an additional regression. The regression results presented in the Table 5 report the marginal effects directly.

We find that using the average AQI from 2 years prior to the survey, air pollution still exerts a significantly negative effect on the willingness of the local migrant population to settle. However, the marginal effects differ somewhat in magnitude from those in the baseline regression, which used the average AQI from the month preceding the survey. Specifically, holding other conditions constant, a 100-unit increase in the AQI from the year prior to the survey results in a decrease of approximately 10.6 percentage points in the willingness of the local migrant population to settle. The absolute value of the marginal effect derived from the average AQI 2 years before the survey is slightly higher than that from the

baseline regression using the AQI from 1 month prior. This may be because the longer two-year period enables local residents to better perceive the effects of air pollution. However, due to the potential for omitted variable bias, the study may suffer from endogeneity, which could lead to imprecise coefficient estimates. The use of lagged variables can help mitigate endogeneity to some extent.

4.3 Heterogeneity analysis

Individuals with different characteristics may display varying sensitivities to air pollution. Therefore, this section conducts grouped regressions from multiple perspectives on the migrant population sample to examine the heterogeneous effects of air pollution on migrants’ willingness to settle.

TABLE 4 Robustness based on air pollution indicators.

Variables	(1)	(2)	(3)	(4)
PM _{2.5} /100	−0.131***			
	(0.0121)			
PM ₁₀ /100		−0.0511***		
		(0.0047)		
NO ₂ /100			−0.3324***	
			(0.0135)	
CO/100				−0.0337***
				(0.0025)
Control Variables	YES	YES	YES	YES
Observations	121642	121642	121642	121642

4.3.1 Gender and marital status

A stable population structure and marriage rate are important guarantees for regional development. Individuals of different genders and marital statuses may have different sensitivities to air pollution. Therefore, this paper first examines the impact of air pollution on the settlement intention of migrants of different genders and marital statuses to remain in a region, providing a basis for the government to formulate differentiated policy measures targeting groups with different individual characteristics. After categorizing the samples, Probit regressions are conducted, with the marginal effects reported directly in Table 6.

In general, air pollution has a significantly negative effect on the willingness of both male and female migrants to settle. Specifically, male migrants exhibit greater sensitivity to changes in air quality than their female counterparts, making them more likely to migrate across provinces or cities. And in terms of marriage, the results in Table 6 show that married migrants are more sensitive to air pollution. Specifically, holding other factors constant, for every 100-point increase in AQI, the willingness to settle among married individuals decreases by approximately 7 percentage points, while among unmarried individuals, the decrease is only about 4.17 percentage points.

In real life, women typically bear a larger share of family-raising and household responsibilities than men. When women have their own families, they tend to become more family-centered, leading to greater life stability. Relocating across provinces or cities often requires moving the entire family, which makes women less inclined to uproot their lives solely due to air pollution. This helps explain why women are less likely than men to move in response to changes in the Air Quality Index. And when it comes to the marriage status, the single migrants, who have not yet taken on the responsibilities of supporting a family, face lower relocation costs and exhibit less short-term sensitivity to air pollution. In contrast, married individuals are more concerned with the physical and mental health of their family members, making them more attuned to the impact of air pollution. Moreover, due to the pervasive nature of this environmental threat, married migrants are more likely to consider the effects on their families when deciding where to settle and work, leading to a significantly higher sensitivity to air pollution.

TABLE 5 Robustness test based on air quality monitoring period.

Variables	(1)	(2)	(3)	(4)
AQI/100	−0.117***	−0.0836***	−0.1764***	−0.1060***
	(0.00529)	(0.0050)	(0.0062)	(0.0059)
Education		0.0775***		0.0729***
		(0.0011)		(0.0011)
Family		0.0362***		0.0385***
		(0.0011)		(0.0011)
Gender		−0.0065***		−0.0048*
		(0.0025)		(0.0025)
Marriage		0.0342***		0.0345***
		(0.0020)		(0.0020)
Flow range		−0.1493***		−0.1527***
		(0.0024)		(0.0025)
Age		0.0018***		0.0016***
		(0.0001)		(0.0001)
Insurance		0.0663***		0.0694***
		(0.0055)		(0.0055)
Year		0.0199***		0.0196***
		(0.0002)		(0.0002)
Population			−0.0048***	−0.0032***
			(0.0003)	(0.0003)
Per_GDP			−0.0034***	−0.0011***
			(0.0003)	(0.0003)
School			0.2716***	0.1694***
			(0.0086)	(0.0082)
Book			0.0003	0.0024***
			(0.0003)	(0.0003)
Observations	121642	121642	121642	121642

TABLE 6 Heterogeneity analysis: gender and marital status.

Variables	Gender		Marital status	
	Male	Females	Married	Unmarried
AQI/100	−0.0728***	−0.0370***	−0.0718***	−0.0417***
	(0.0110)	(0.0129)	(0.0089)	(0.0228)
Controls	YES	YES	YES	YES
Observations	70533	51109	100616	21026

4.3.2 Age

Age is another crucial personal characteristic to consider in this study. As it is well known that air pollution affects human health, and individuals in different age groups exhibit varying

TABLE 7 Heterogeneity analysis: age.

Variables	Age		
	15–30 years	31–50 years	>50 years
AQI/100	–0.0171	–0.0805***	–0.1755***
	(0.0149)	(0.0105)	(0.0315)
Controls	YES	YES	YES
Observations	40219	71468	9955

levels of physical constitutions. Therefore, it is meaningful to explore the sensitivity of different age groups to air pollution. It can also provide suggestions for the government on how to attract young talents and alleviate labour shortages caused by population ageing.

This study divides the sample into three age groups: 15–30 years, 31–50 years, and over 50 years, and conducts separate regressions for each group. The marginal effects of the Air Quality Index (AQI) for each subgroup are presented in the three columns of Table 7. Although air pollution negatively impacts the willingness to settle across all age groups, the estimated coefficients for the core explanatory variable vary among the three categories. Specifically, holding other factors constant, a 100-unit increase in AQI leads to a decrease of 8.05 percentage points in the willingness to settle among the 31–50 age group. The decrease is even more pronounced for individuals over 50 years old. Moreover, the effect of air pollution on the willingness to settle is statistically significant at the 1% level for both the 31–50 and over 50 age groups, while this negative effect is not significant for the 15–30 age group.

The possible reasons for the above results may include the following: First, individuals over the age of 50 are more likely to suffer from various health conditions, which leads them to place greater emphasis on their physical wellbeing. As a result, they are more concerned about air quality. When air pollution levels are high, they are more inclined to relocate to areas with better air quality to protect their health. In contrast, the younger age group (15–30 years) is generally in good health, and thus their concern about air quality is less pronounced due to their current physical condition. Second, individuals in the 15–30 age group may not have settled down yet, as this period is typically focused on seeking better opportunities. They tend to prioritize employment prospects, career

growth, and the economic vitality of cities, which provide more immediate economic benefits. Therefore, air pollution is not a primary consideration in their decision-making. Moreover, young people are generally more willing to explore new opportunities, making them more likely to move to different locations. Third, individuals in the 31–50 age group often have established families and careers. Relocation at this stage usually entails a change in work environment and the need to move the entire family, which involves higher relocation costs and a stronger desire for stability. As a result, their sensitivity to air quality is relatively lower in the short term compared to the older age group, as they prioritize family and career stability.

4.3.3 Nature of employment

Cross-provincial migration often involves the relocation of entire families, changes in work environments and other factors, raising the question of whether air pollution is a significant enough reason for people to alter their city if residence? When deciding whether to migrate, people often consider long-term benefits, so the change in employment is also a significant factor to carefully consider. This study examines the heterogeneous effects of the nature of existing workplaces, and the results in Table 8 can also provide recommendations for the development of different industries and regions.

Population Dynamic Monitoring Survey Database provides data on the nature of respondents' workplaces. Based on the survey responses, employment is categorized into the following five types: (1) Government Agencies, Party and Mass Organizations, and Public Institutions. (2) Professional and Technical Personnel. (3) Commercial and Service Industry Personnel. (4) Agriculture, Forestry, Animal Husbandry, Fishery, and Water Conservancy Personnel. (5) Production, Transportation Equipment, and Related Personnel. After grouping the samples accordingly, separate regressions are conducted for each category. The regression results indicate that, firstly, the negative impact of air pollution on the willingness to settle among migrants is not significant for those employed in government agencies, party and mass organizations, public institutions, or as professional and technical personnel. However, for the remaining three categories, the negative impact is significant. Secondly, personnel in agriculture, forestry, animal husbandry, fishery, and water conservancy exhibit the highest sensitivity to air pollution. A 100-unit increase in the AQI results in a significant decrease of approximately 14 percentage

TABLE 8 Heterogeneity analysis: nature of employment.

Variables	Classified by occupation				
	Government agencies, party and Mass organizations, and public institutions	Professional and technical personnel	Commercial and service industry personnel	Commercial and service industry personnel	Production, transportation equipment, and related personnel
AQI/100	–0.0360	–0.0018	–0.0257**	–0.1432*	–0.0997***
	(0.0394)	(0.0234)	(0.0108)	(0.0807)	(0.0191)
Controls	YES	YES	YES	YES	YES
Observations	3643	13464	72644	1335	25708

points in their settlement intention. Finally, air pollution has the most pronounced impact on individuals in the commercial and service industries, as well as those involved in production, transportation equipment, and related sectors.

The possible reasons for the above results may include the following: In contemporary society, jobs within government agencies and public institutions are often viewed as “iron rice bowls,” signifying job stability and satisfactory welfare benefits, making them less susceptible to change. As a result, the negative impact of air pollution on the willingness to settle is mitigated for individuals in these sectors. Those with stable incomes and secure jobs are more likely to retain their current living and working conditions rather than relocate for improved air quality. And then, personnel in agriculture, forestry, animal husbandry, fishery, and water conservancy sectors are highly dependent on environmental conditions. Air pollution can adversely affect their production activities, undermining both product and sales. Consequently, these industries are most sensitive to air pollution. Lastly, the commercial and service industries, as well as those involved in production, transportation equipment, and related sectors are often characterized by instability, and workers in similar industries can more easily switch jobs, thereby weakening the link between the nature of their employment and their willingness to settle.

4.3.4 Income level

Income inequality is also a pressing social issue today, reflecting disparities in educational attainment and resource endowments. Through further analyzing how different income levels influence the settlement intentions of migrant populations, this study contributes to a deeper understanding of environmental exposure inequities stemming from income disparities. Moreover, the findings can provide valuable insights for policymakers to refine social security systems and promote equitable environmental governance.

We further analyze the impact of income levels on the willingness of the migrant population to settle. The monthly average income is categorized into three groups: below ¥5,000, ¥5,000–¥10,000, and above ¥10,000, and separate regressions are conducted for each group. The regression results in [Table 9](#) indicate that air pollution has a significantly negative effect on the willingness to settle for migrants across all income levels, though the extent of this impact varies. As income level becomes higher, the negative effect of air pollution on settlement intention increases.

This may be because higher-income groups enjoy more options. They can adjust their personal leisure time, or leverage higher education and specialized technical skills to access a wider range of job opportunities. Once basic living needs are met, higher-income individuals are more likely to prioritize an improved quality of life, placing greater importance on environmental and health factors. Consequently, air pollution has a more pronounced effect on their willingness to settle. In contrast, for low-income groups, securing wages to sustain livelihoods and support families is often the primary concern. Additionally, low-income individuals typically lack competitive advantages such as higher education in the job market, resulting in less employment flexibility. Consequently, these individuals may find themselves in a “no choice” situation, where maintaining employment and income takes precedence over concerns about air pollution. As a result, low-income migrants

TABLE 9 Heterogeneity analysis: income level.

Variables	Income		
	<5,000	5,000–10000	>10000
AQI/100	−0.0400**	−0.0692***	−0.0809***
	(0.0178)	(0.0119)	(0.0154)
Controls	YES	YES	YES
Observations	29428	60686	31528

Finally, we utilize a graph to show all the heterogeneity.

are less likely to relocate solely due to air pollution. We use visualizations ([Figure 2](#)) to summarize heterogeneous results.

5 Mechanism analysis

The empirical analyses presented earlier have shown that urban air pollution has a significantly negative effect on the willingness of the migrant population to settle, with clear heterogeneity in this relationship. The underlying mechanisms driving this effect warrant further exploration. On one hand, we suggest that air pollution directly impacts the health of migrants, thereby reducing their willingness to settle. On the other hand, long-term exposure to polluted environments can harm physical health, particularly by increasing the incidence of respiratory diseases. This, in turn, may reduce the labor supply ([Hanna and Oliva, 2015](#)). A reduction in labor supply could, in turn, lower potential earnings. Therefore, this study posits that the impact of air pollution on the willingness of the migrant population to settle may also follow the logic of the following causal chains “Air Pollution → Reduced Labor Supply → Decreased the settlement intention” and “Air Pollution → Reduced Labor Income → Decreased the settlement intention of urban migrants”. In summary, this study introduces the health status of migrants, average weekly working hours, and average monthly household income as mediating variables to explore the mechanisms through which air quality affects the settlement intention of urban migrants.

The empirical analyses presented earlier have shown that air pollution has a significantly negative effect on the settlement intention of urban migrants, with clear heterogeneity in this relationship. The underlying mechanisms driving this effect warrant further exploration. On one hand, we suggest that air pollution directly impacts the health of migrants, thereby reducing their willingness to settle. On the other hand, long-term exposure to polluted environments can harm physical health, particularly by increasing the incidence of respiratory diseases. This, in turn, may reduce the labor supply ([Hanna and Oliva, 2015](#)). A reduction in labor supply could, in turn, lower potential earnings. Therefore, this study posits that the impact of air pollution on the willingness of the migrant population to settle may also follow the logic of the following causal chains “Air Pollution → Reduced Labor Supply → Decreased Willingness to Settle” and “Air Pollution → Reduced Labor Income → Decreased Willingness to Settle” In summary, this study introduces the health status of migrants, average weekly working hours, and average monthly household

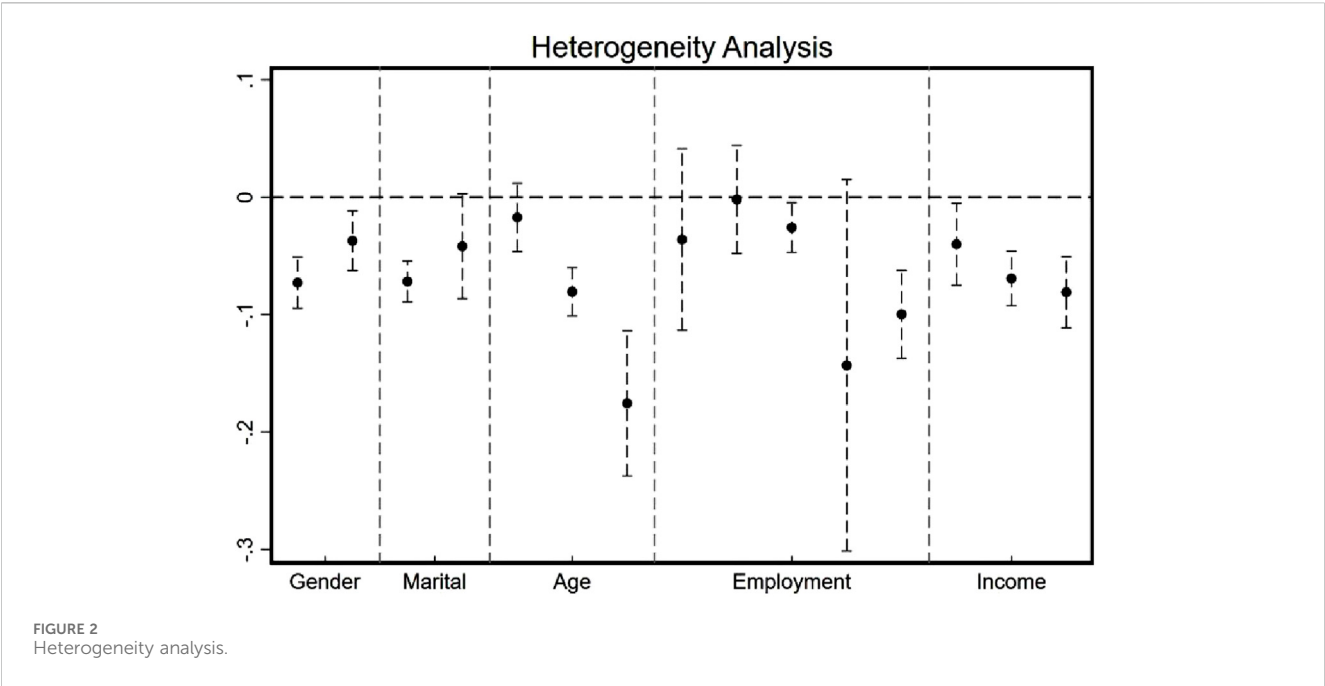


TABLE 10 KHB decomposition method test results.

Variables	Self-assessed health status	Externally-assessed health status
Total Effect	−0.2604***	−0.2622***
	(0.0260)	(0.0259)
Direct Effect	−0.2182***	−0.1854***
	(0.0276)	(0.0277)
Indirect Effect	−0.0422***	−0.0767***
	(0.0145)	(0.0147)
Controls	YES	YES
Observations	121642	121642

income as mediating variables to explore the mechanisms through which urban air quality affects the settlement intention of urban migrants.

According to the KHB decomposition results (Table 10), both self-assessed and externally assessed health statuses exhibit significant total effects, direct effects, and indirect effects at the 1% significance level. After controlling for health status, the result suggests that air pollution leads to poorer health, which in turn reduces the willingness to settle. This finding indicates that health status partially mediates the relationship between air pollution and settlement intentions, highlighting the importance of considering health outcomes when examining the effects of environmental factors on migration decisions.

To explore whether air pollution influences the settlement intention of urban migrants by reducing household income and weekly working hours, this study extracts data on household average monthly income and respondents' average weekly working hours from the survey. The KHB decomposition results in Table 11 reveal

that air pollution continues to have a significantly negative impact on the willingness of migrants to settle, with total effects, direct effects, and indirect effects all being significant at the 1% level.

Firstly, with regard to household average monthly income, the indirect effect is −0.0593, which is significant at the 1% level. This indicates that air pollution reduces household average monthly income, thereby decreasing the willingness to settle. This could be due to the increased medical expenditures in environments with poor air quality, which lowers household income. Moreover, air pollution may lead to reduced productivity and absenteeism, further impacting household income.

In addition, the indirect effect of average weekly working hours is also significantly negative at the 1% level. This suggests that air pollution can reduce the willingness to settle by decreasing the average weekly working hours of individuals. Health plays a crucial role in overall wellbeing: good physical and mental health enriches daily life, boosts enthusiasm for living, and provides greater motivation and capacity for longer working hours. Poor air

TABLE 11 KHB decomposition method test results.

Variables	Average monthly household income	Average number of hours worked per week
Total Effect	−0.2527***	−0.2519***
	(0.0259)	(0.0259)
Direct Effect	−0.1934***	−0.2131***
	(0.0276)	(0.0277)
Indirect Effect	−0.0593***	−0.0388***
	(0.0144)	(0.0145)
Controls	YES	YES
Observations	121642	121642

quality can lead to various health issues, such as respiratory problems, fatigue, and reduced cognitive function, which may limit an individual’s ability to work long hours. Furthermore, there is a strong link between working hours and income, as reduced working hours often translate to lower earnings.

These findings highlight the multifaceted nature of the relationship between air pollution and settlement intentions, with both household income and working hours serving as important mediating factors. Policymakers and urban planners should consider the broader economic and health implications of air pollution when developing strategies to attract and retain migrant populations in cities.

In the above analysis, we used a mediation effect to examine the mechanism of air pollution’s impact on the migrants’ settlement intention. But how can the adverse effects of air pollution on migrants’ settlement intentions be mitigated? Maybe this is an more important challenge for policymakers. Therefore, we will continue to use Equation 2 to study the moderating effect of urban green coverage.

$$settle_{i,j} = \alpha_0 + \beta_1AQI_j + \beta_2Green_j + \beta_3AQI_j*Green_j + \beta_4X_i + \beta_5C_j + \varepsilon_i \tag{2}$$

As the result shown in Table 12, after adding the interaction term in column (2), for every 100-unit increase in AQI, the urban migrants’ settlement intention decreases by 6.69%. Compared with column (1), the negative impact of air pollution on the settlement intention of urban migrants has been reduced. Moreover, the coefficient of the interaction term AQI*Green is positive and significant at the 1% significance level, confirming that urban green coverage can effectively mitigate the negative impact of air pollution on the urban migrants’ settlement intention. In other words, the higher the urban green coverage, the more it can mitigate the negative impact of air pollution on the settlement intention of urban migrants.

6 Conclusion and policy implication

6.1 Conclusion

In recent years, the issues arising from traditional production models, which prioritize economic growth at the expense of

TABLE 12 Moderating effect analysis results.

Variables	(1)	(2)
AQI/100	−0.1325**	−0.0669***
	(0.0531)	(0.0084)
Green		0.0508***
		(0.0122)
AQI*Green		0.3203***
		(0.0978)
Controls	YES	YES
Observations	121642	121642

environmental sustainability, have become increasingly prominent. Air pollution has emerged as a critical concern for various sectors of society, and ecological protection has become a central development strategy for many countries. As people’s demands for a higher quality of life continue to rise, their focus on air pollution intensifies, leading to a growing desire to implement measures that mitigate its negative impact on daily life and health. In China, with its large migrant population, the challenge lies not only in traditional economic factors but also in environmental issues such as air quality, which are progressively becoming key elements in a city’s competitiveness in attracting and retaining human capital. Consequently, exploring the impact of air pollution on the settlement intention of the urban migrants, and accurately estimating the magnitude of this effect, is of significant importance for labor force selection and urban development.

This study examines the impact of air pollution on the settlement intention of the urban migrants, highlighting its heterogeneous characteristics. The following research conclusions are drawn.

First, air pollution is negatively associated with the settlement intention of the urban migrants. After incorporating instrumental variables and controlling for personal characteristics such as age, gender, education level, marital status, as well as city characteristics like year-end population, *per capita* GDP, number of higher education institutions, and number of public libraries, an increase of 100 units in the AQI leads to a significant decrease of

approximately 13.25 percentage points in the probability that local migrants are willing to settle.

Second, there is notable heterogeneity in the relationship between air pollution and willingness to settle among different migrant groups: (1) Under the same level of air pollution, males are more inclined to migrate than females. (2) Married individuals are more sensitive to air pollution due to their consideration for the health of their family members, making them more concerned about environmental conditions compared to unmarried individuals. (3) Middle-aged and elderly individuals (over 50 years old) are more attentive to air pollution and its effects on their health. (4) Individuals with “iron rice bowl” job security are less sensitive to air pollution in terms of their willingness to settle. Conversely, those engaged in agriculture, forestry, animal husbandry, fishery, and water conservancy are more sensitive to air pollution, likely due to its direct impact on their work. (5) Higher-income groups are more affected by air pollution in their willingness to settle, possibly due to their greater access to options for relocation and a stronger focus on quality of life.

Third, robustness checks were performed by substituting the average AQI of the 2 years preceding the survey year for the original core explanatory variable, and by using other common air quality indicators such as PM_{2.5} and PM₁₀ as proxies for air quality. The results remained consistent. Further analysis revealed that air pollution reduces the willingness of the migrant population to settle by deteriorating their health status and decreasing their working hours and income.

6.2 Policy implication

Based on the conclusion obtained, this study offers policy implications in three main dimensions. The first policy implication is that governments need to strengthen environmental governance and regulation. At the present, governments have shown that talent is the primary resource, which underscores the role of high-quality human capital as the driving force behind regional and societal development. In response, cities across China are continuously introducing innovative talent recruitment policies and enhancing welfare measures—such as increasing income, housing, medical, and educational subsidies—to attract and retain a skilled workforce. However, environmental quality should also be a key consideration in this process. As the saying goes, “Lucid waters and lush mountains are invaluable assets.” A high-quality living environment is intrinsically linked to the physical and mental wellbeing of residents, as well as their overall quality of life. Therefore, policymakers should not overlook the growing demand for both local environmental quality and the livability attributes of cities. While the study acknowledges that urban economic development remains a critical factor for migrants when selecting their employment destinations, and that cities with strong economic power tend to attract talent, it is important to note that the economic strength of a city can, to some extent, mitigate the negative effects of air pollution on its ability to attract human capital. However, people’s physical and mental health cannot be quantified or replaced by financial incentives. Consequently, as public expectations for quality of life continue to rise, it is imperative for cities to not only focus on economic growth but also invest in improving environmental quality in the long term. Measures can include

controlling concentrations of PM_{2.5} and hazardous gases, strengthening supervision of polluting enterprises, improving environmental quality, enhancing urban public services, and building ecologically sustainable and livable cities. These efforts may become another effective means of attracting human capital beyond economic development.

The heterogeneity analysis presented in this study provides valuable insights for urban policymakers, helping to refine and target strategies for sustainable development. So the second policy implication is that by understanding the varying sensitivities of different migrant groups to air pollution, policymakers can develop more nuanced and effective interventions to attract and retain specific demographics. For example, cities may prioritize environmental improvements in areas with a higher concentration of middle-aged and elderly residents, or provide employment and income security for low-income level groups in order to narrow the income gap of the society, or focus on promoting green industries and sustainable agricultural practices, support environmentally sensitive industries such as agriculture, forestry, animal husbandry, and fisheries to ensure their production and sales. These measures would not only enhance environmental resilience but also improve social equity. Finally, from a health perspective, while governing the environment, governments should also increase investment in healthcare to protect people’s health and improve the social security system.

And then, policy interventions must be strategically differentiated according to urban hierarchy and developmental context. Megacities, which often face acute pollution challenges, should prioritize vigorous mitigation measures—including investment in green infrastructure, expansion of public transportation networks, and strict enforcement of industrial emission standards—while consciously recognizing the inherent trade-offs migrants undertake when balancing economic opportunity against environmental quality. The overarching objective for such metropolises should be the steady enhancement of urban livability to sustainably retain skilled populations. In contrast, smaller or less-developed cities experiencing both environmental degradation and net outmigration may capitalize on ecological improvement as a distinctive competitive edge. Such cities would benefit from deploying targeted incentives, such as subsidized housing, enhanced healthcare and educational provisions, and tailored support for pollution-vulnerable industries including agriculture, expressly designed to attract migrants seeking alternatives to heavily polluted major urban centers. This spatially nuanced policy framework enables cities to strategically leverage their comparative advantages in the competition for human capital.

Furthermore, this study highlights a critical distinction between individual coping mechanisms and systemic solutions to environmental challenges. While migration represents a rational adaptation strategy for individuals seeking to avoid the detrimental effects of air pollution, it is an incomplete remedy at the societal level. Achieving sustainable outcomes necessitates comprehensive, system-level interventions. These include stringent environmental regulations, a decisive transition towards clean energy, and the integration of green infrastructure into urban planning. The successful implementation of such macro-level transformations depends crucially on synergistic action between policymakers and an engaged public. Cultivating a high level of environmental literacy among citizens—conceptualized here as a “Nature Quotient” (NQ), or the capacity to understand and harmonize with natural

systems—is fundamental to building the social consensus required to support and sustain these necessary policies (Vuong and Nguyen, 2025). Therefore, a vital third policy implication is to embed environmental education and public awareness initiatives into governance strategies. By elevating the public's NQ, governments can foster a populace that not only adapts to change but also actively participates in forging a sustainable model of development for the society.

In conclusion, this study highlights the importance of considering environmental factors, particularly air pollution, in the development of urban policies aimed at attracting and retaining human capital. The findings of this study offer valuable insights for Chinese cities aiming to attract and retain labor through improvements in environmental quality. As Chinese cities continue to compete for talent, those that prioritize both economic growth and environmental sustainability are likely to emerge as more attractive destinations for migrants in the long run. By investing in the creation of livable, sustainable urban environments, cities can not only improve the quality of life for their residents but also position themselves as competitive hubs for talent and innovation in the years to come.

This study has limitations that suggest directions for future research. Primarily, the reliance on cross-sectional data restricts our ability to fully establish causality, despite the use of instrumental variables. Future work should employ panel data to better track how changing pollution levels dynamically affect settlement intentions. Furthermore, while our micro-level analysis identifies mechanisms that reduce settlement intention, it does not directly explain the macro “pollution-migration paradox” observed in megacities, where strong economic pull factors likely override environmental concerns to sustain in-migration. Future research should integrate micro-level intentions with macro migration data to identify the economic opportunity thresholds that override environmental disamenities in migration decisions.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

LH: Formal Analysis, Writing – original draft, Software, Methodology, Data curation. ZZ: Writing – review and editing,

Writing – original draft, Methodology. LZ: Writing – review and editing. CW: Supervision, Writing – review and editing.

Funding

The author(s) declare that no financial support was received for the research and/or publication of this article.

Acknowledgments

The authors appreciate the comments from the editors and reviewers. And we also would like to express our sincere gratitude to Wang Yu, who offered useful suggestions for the writing of this article. We also deeply appreciate Chen Qinyi, for her meticulous proofreading and language polishing, which significantly improved the clarity and fluency of this work.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declare that no Generative AI was used in the creation of this manuscript.

Any alternative text (alt text) provided alongside figures in this article has been generated by Frontiers with the support of artificial intelligence and reasonable efforts have been made to ensure accuracy, including review by the authors wherever possible. If you identify any issues, please contact us.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

- Ahumada, G., and Iturra, V. (2021). If the air was cleaner, would we be happier? An economic assessment of the effects of air pollution on individual subjective well-being in Chile. *J. Clean. Prod.* 289, 125152. doi:10.1016/j.jclepro.2020.125152
- Akaraci, S., Feng, X., Suesse, T., Jalaludin, B., and Astell-Burt, T. (2022). Associations between green space, air pollution and birthweight in sydney metropolitan area, Australia. *Urban For. Urban Green* 76, 127726. doi:10.1016/j.ufug.2022.127726
- Altansukh, B., Rahut, D. B., and Bera, S. (2025). Breathing hazards: how air quality diminishes labor supply in ulaanbaatar, Mongolia. *Environ. Challenges* 18, 101072. doi:10.1016/j.envc.2024.101072
- Cai, Y., Zhou, M., and Chow, J. A. (2018). Study on the influence of air pollution on labor supply—based on the perspective of healthy human capital. *Soc. Secur. Stud.* 6, 59–68. doi:10.3969/j.issn.1674-4802.2018.06.005
- Chang, Y. H., Chen, T., Chung, H., Hsiao, H. Y., Tseng, P. C., Wang, Y. C., et al. (2024). The health risk reduction of pm2.5 via a green curtain system in taiwan. *Build. Environ.* 255, 111459. doi:10.1016/j.buildenv.2024.111459
- Chay, K. Y., and Greenstone, M. (2003). The impact of air pollution on infant mortality: evidence from geographic variation in pollution shocks induced by a recession. *Quart. J. Econ.* 118, 1121–1167. doi:10.1162/00335530360698513

- Chen, S., Guo, C., and Huang, X. (2018). Air pollution, student health, and school absences: evidence from China. *J. Environ. Econ. Manag.* 92, 465–497. doi:10.1016/j.jeem.2018.10.002
- Chen, R., Wang, J., Yang, W., Chen, M., Wang, Q., and Li, K. (2023). Influence factors of atmospheric boundary layer inversion in Yinchuan City and the relation with PM2.5 in winter. *J. Arid. Meteorol.* 41, 123–132. doi:10.11755/j.issn.1006-7639(2023)-01-0123
- Choudhary, A., Kumar, P., Pradhan, C., Sahu, S. K., Chaudhary, S. K., Joshi, P. K., et al. (2023). Evaluating air quality and criteria pollutants prediction disparities by data mining along a stretch of urban-rural agglomeration includes coal-mine belts and thermal power plants. *Front. Environ. Sci.* 11, 1132159. doi:10.3389/fenvs.2023.1132159
- Chu, Y. S., Liu, Y., and Liu, M. (2015). The research of the mobility of heterogeneous labors with the pollution effects: spatial empirical analysis based on the discrete choice model. *Ind. Econ. Rev.* 6, 45–56. doi:10.14007/j.cnki.cjpl.2015.04.005
- Currie, J., and Neidell, M. (2005). Air pollution and infant health: what can we learn from California's recent experience? *Quart. J. Econ.* 120, 1003–1030. doi:10.1093/qje/120.3.1003
- Deschênes, O., Greenstone, M., and Shapiro, J. S. (2017). Defensive investments and the demand for air quality: evidence from the nox budget program. *Am. Econ. Rev.* 107 (10), 2958–2989. doi:10.1257/aer.20131002
- Feng, T., Chen, X., Ma, J., Sun, Y., Du, H., Yao, Y., et al. (2023). Air pollution control or economic development? Empirical evidence from enterprises with production restrictions. *J. Environ. Manag.* 336, 117611. doi:10.1016/j.jenvman.2023.117611
- Fu, S., and Gu, Y. (2017). Highway toll and air pollution: evidence from Chinese cities. *J. Environ. Econ. Manag.* 83, 32–49. doi:10.1016/j.jeem.2016.11.007
- Germani, A. R., Scaramozzino, P., Castaldo, A., and Talamo, G. (2021). Does air pollution influence internal migration? An empirical investigation on Italian provinces. *Environ. Sci. Policy* 120, 11–20. doi:10.1016/j.envsci.2021.02.005
- Hanna, R., and Oliva, P. (2015). The effect of pollution on labor supply: evidence from a natural experiment in Mexico City. *J. Public Econ.* 122, 68–79. doi:10.1016/j.jpubeco.2014.10.004
- Harris, J. R. (1970). Migration, unemployment and development: a two-sector analysis. *Am. Econ. Rev.* 60, 126–142. Available online at: <https://www.jstor.org/stable/1807860>.
- Hu, Z., Zhang, Y., Cao, J., and Zhou, K. (2022). Longing for the Blue Sky: urban air quality and the individual decision to immigrate. *J. Asian Econ.* 79, 101437. doi:10.1016/j.asieco.2021.101437
- Huang, X., and Lanz, B. (2018). The value of air quality in Chinese cities: evidence from labor and property market outcomes. *Environ. Resour. Econ.* 71, 849–874. doi:10.1007/s10640-017-0186-8
- Jayachandran, S. (2009). Air quality and early-life mortality: evidence from Indonesia's wildfires. *J. Hum. Resour.* 44, 916–954. doi:10.3386/w14011
- Knittel, C. R., Miller, D. L., and Sanders, N. J. (2016). Caution, drivers! Children present: traffic, pollution, and infant health. *Rev. Econ. Stat.* 98, 350–366. doi:10.3386/w17222
- Kumar, R. P., Prakash, A., Singh, R., and Kumar, P. (2024). Machine learning-based prediction of hazards fine pm2.5 concentrations: a case study of Delhi, India. *Discov. Geosci.* 2 (1), 34. doi:10.1007/s44288-024-00043-z
- Lee, E. S. (1966). A theory of migration. *Demography* 3, 47–57. doi:10.2307/2060063
- Levinson, A. (2012). Valuing public goods using happiness data: the case of air quality. *J. Public Econ.* 96, 869–880. doi:10.1016/j.jpubeco.2012.06.007
- Li, J. (2014). The effects of air pollution on labor force participation: empirical research from China. *J. China Econ. Stud.* 5, 67–77. doi:10.19365/j.issn1000-4181.2014.05.007
- Li, X., and Li, Y. (2022). The impact of perceived air pollution on labour supply: evidence from China. *J. Environ. Manag.* 306, 114455. doi:10.1016/j.jenvman.2022.114455
- Li, R., and Ramanathan, R. (2018). Exploring the relationships between different types of environmental regulations and environmental performance: evidence from China. *J. Clean. Prod.* 196, 1329–1340. doi:10.1016/j.jclepro.2018.06.132
- Li, Y., Cheng, Q., and Liu, C. (2021). An analysis of the effect of air pollution on women's working time. *J. Popul. Soc.* 37, 87–97. doi:10.14132/j.2095-7963.2021.05.008
- Li, B., Huang, J., and Zhang, Y. (2023). The impacts of air pollution on immigrants' settlement intention in China. *Environ. Sci. Pollut. Res.* 30, 46587–46603. doi:10.1007/s11356-023-25149-8
- Li, Y., Peng, J., Ni, M., Bai, Y., Liu, Q., and Li, C. (2024). Air pollution control and carbon reduction policies: assessing effectiveness in alleviating PM2.5-associated mortality in China. *Environ. Int.* 188, 108742. doi:10.1016/j.envint.2024.108742
- Lim, Y.-H., Bilsteen, J. F., Mortensen, L. H., Lanzky, L. R. M., Zhang, J., Tuffier, S., et al. (2024). Lifetime exposure to air pollution and academic achievement: a nationwide cohort study in Denmark. *Environ. Int.* 185, 108500. doi:10.1016/j.envint.2024.108500
- Liu, Z., and Yu, L. (2020). Stay or leave? The role of air pollution in urban migration choices. *Ecol. Econ.* 177, 106780. doi:10.1016/j.ecolecon.2020.106780
- Liu, M., Timmermans, E. J., Zou, D., Grobbee, D. E., Zhou, S., and Vaartjes, I. (2024a). Impact of green space exposure on blood pressure in guangzhou, China: mediation by air pollution, mental health, physical activity, and weight status. *Environ. Pollut.* 356, 124251. doi:10.1016/j.envpol.2024.124251
- Liu, P., Xu, Y., and Lu, J. (2024b). Air pollution, sustainable development, and corporate R&D: evidence from emerging countries. *J. Environ. Manag.* 369, 122368. doi:10.1016/j.jenvman.2024.122368
- Masuda, Y. J., Garg, T., Anggraeni, I., Ebi, K., Krenz, J., Game, E. T., et al. (2021). Warming from tropical deforestation reduces worker productivity in rural communities. *Nat. Commun.* 12 (1), 1601. doi:10.1038/s41467-021-21779-z
- Neidell, M. J. (2004). Air pollution, health, and socio-economic status: the effect of outdoor air quality on childhood asthma. *J. Health Econ.* 23, 1209–1236. doi:10.1016/j.jhealeco.2004.05.002
- Neidell, M. (2009). Information, avoidance behavior, and health: the effect of ozone on asthma hospitalizations. *J. Hum. Resour.* 44, 450–478. doi:10.3386/w14209
- Shang, L., Yang, L., Yang, W., Xie, G., Wang, R., Sun, L., et al. (2022). Prenatal exposure to air pollution and the risk of macrosomia: identifying windows of susceptibility. *Sci. Total Environ.* 818, 151775. doi:10.1016/j.scitotenv.2021.151775
- Shen, L., Yang, Y., Bao, H., Du, X., and He, H. (2023). Residents' perceptions on the urban resources environment in Chinese large cities. *Environ. Impact Assess. Rev.* 100, 107080. doi:10.1016/j.eiar.2023.107080
- Sheng, P., Yang, J., and Ding, Z. (2016). Impact of environmental pollution on labor supply in China: research based on panel error corrected model. *J. Technol. Econ.* 35, 119–125. doi:10.3969/j.issn.1002-980X.2016.01.018
- Slovic, P. (1987). Perception of risk. *Science* 236, 280–285. doi:10.1126/science.3563507
- Speare, A. (1974). Residential satisfaction as an intervening variable in residential mobility. *Demography* 11, 173–188. doi:10.2307/2060556
- Sun, Z., and Sun, C. (2018). Be alert to “Counter Urbanization” induced by air pollution: based on an empirical study of the settlement intention of floating population. *J. South China Norm. Univ. Soc. Sci. Ed.* 50, 135–142.
- Sun, W., Zhang, X., and Zheng, S. (2019). Air pollution and spatial mobility of labor force: study on the Migrants' job location choice. *Econ. Res. J.* 54, 102–117.
- Tanaka, S. (2015). Environmental regulations on air pollution in China and their impact on infant mortality. *J. Health Econ.* 42, 90–103. doi:10.1016/j.jhealeco.2015.02.004
- Vilhelmson, B., and Thulin, E. (2013). Does the Internet encourage people to move? Investigating Swedish young adults' internal migration experiences and plans. *Geoforum* 47, 209–216. doi:10.1016/j.geoforum.2013.01.012
- Vuong, Q. H. (2021). The semiconducting principle of monetary and environmental values exchange. *Econ. Bus. Lett.* 10 (3), 284–290. doi:10.17811/eb.10.3.2021.284-290
- Vuong, Q. H., and Nguyen, M. H. (2025). On nature quotient. *Pac. Conserv. Biol.* 31, PC25028. doi:10.1071/pc25028
- Wang, L., Wang, L. Y., and Lin, D. (2016). Telephone survey on the current situation of smog protection behavior of urban residents in Beijing. *China Health Education.* 32 (11), 024–106. doi:10.16168/j.cnki.issn.1002-9982.2016.11.017
- Wolpert, J. (2010). Migration as an adjustment to environmental stress. *J. Soc.* 22, 92–102. doi:10.1111/j.1540-4560.1966.tb00552.x
- Wu, M., Xu, C., and Tang, L. (2022). Manufacturing agglomeration, intelligent manufacturing and labor mobility. *Statistics and Decision-Making.* 38 (17), 155–159. doi:10.13546/j.cnki.tjyc.2022.17.030
- Xiao, T. (2016). Whether the environmental quality is the leading factor of labor mobility. *J. Econ. Rev.* 2, 3–17. doi:10.19361/j.er.2016.02.001
- Xu, X., and Sylwester, K. (2016a). The effects of foreign direct investment on emigration: the roles of FDI source country, education, and gender. *Econ. Model.* 55, 401–409. doi:10.1016/j.econmod.2016.03.001
- Xu, X., and Sylwester, K. (2016b). Environmental quality and international migration. *Kyklos* 69 (1), 157–180. doi:10.1111/kykl.12107
- Xu, F., Xie, Y., and Zhou, D. (2022). Air pollution's impact on the settlement intention of domestic migrants: evidence from China. *Rev.* 95, 106761. doi:10.1016/j.eiar.2022.106761
- Yamada, D., and Narita, D. (2025). Effects of air pollution on labor supply: evidence from Japan. *J. Environ. Econ. Manag.* 132, 103178. doi:10.1016/j.jeem.2025.103178
- Ye, H., Huang, Z., and Chen, S. (2023). Air pollution and agricultural labor supply: Evidence from China. *China Economic Review.* 82, 102075. doi:10.1016/j.chieco.2023.102075
- Yue, Q., Song, Y., Zhang, M., Zhang, X., and Wang, L. (2024). The impact of air pollution on employment location choice: evidence from China's migrant population. *Environ. Impact Assess. Rev.* 105, 107411. doi:10.1016/j.eiar.2023.107411
- Zhang, J., and Mu, Q. (2018). Air pollution and defensive expenditures: evidence from particulate-filtering facemasks. *J. Environ. Econ. Manag.* 92, 517–536. doi:10.1016/j.jeem.2017.07.006
- Zhang, G., Ren, Y., Yu, Y., and Zhang, L. (2022). The impact of air pollution on individual subjective well-being: evidence from China. *J. Clean. Prod.* 336, 130413. doi:10.1016/j.jclepro.2022.130413
- Zhao, H., Liu, X., and Tao, X. (2021). The Spatial and temporal effect on labor supply time—empirical evidence from China labor-force dynamics survey. *Econ. Perspect.* 11, 76–90.
- Zhu, Z. (2015). Is labor supply sensitive to city air pollution? –Based on the dynamic monitoring data of national migrant population in 2012. *J. Res. Econ. Manag.* 36, 47–57. doi:10.13502/j.cnki.issn1000-7636.2015.11.008