Regional Air Quality and Executive Mobility

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Abstract

This thesis examines the impacts of regional air quality on executive mobility in China, positing that poor regional air quality has enduring impacts on executive turnover, thus influencing executives' career paths and choice of workplace in the long term. Using air quality data from prefecture-level cities and a unique dataset to track executives of listed companies from 2010 to 2018 in China, I find that executives located in polluted areas are more likely to relocate to cities with better air quality after turnover, and with no subsequent observable effects on their salaries. These findings remain robust even after controlling for firm performance as an alternative explanation for executives changing their workplace, using alternative measures for regional air quality, and employing a regression discontinuity design (RDD) to address endogeneity concerns. Moreover, the impacts of regional air quality on executive mobility appear to be more pronounced among executives of non-state-owned listed companies. This suggests that regional air quality significantly influences executive decisions regarding work locations and career trajectories. The study contributes to understanding the effects of brain drain by highlighting how local environmental conditions affect a region's capacity to retain and attract executive talent in China. Additionally, it provides insights into the decision-making processes related to the choice of location of the firm's headquarters, talent retention strategies, and environmental regulations. In summary, this research provides a comprehensive insight into the long-term relationship between regional air quality and executive turnover dynamics.

Key words: Regional air quality; Brain drain; Executive turnover; Executive mobility; Compensation; China

1. Introduction

Ambient air pollution has become a growing environmental, social, and health concern in recent years. According to a report by the European Environment Agency in 2015, it is identified as the primary environmental health risk in Europe. Existing studies demonstrate that there is a positive association between air pollution and firms' executive turnover. Regional air quality is a significant factor when executives change their workplace, given the potential long-term effects on their health and overall quality of life, thus increasing executive turnover (Hao et al., 2023; Levine et al., 2018; Xue et al., 2021; Zhu et al., 2021).[1] However, there remains a gap in understanding of the broader implications of this relationship, particularly regarding executives' career paths following turnover caused by air pollution. This study aims to explore the relationship between regional air quality and executive mobility in China. Investigating this phenomenon can provide deeper insights into the challenges and opportunities faced by executives who undergo turnover due to substandard air quality. For instance, it would shed light on whether they encounter difficulties securing new positions or transitioning into different industries. Furthermore, the study could identify specific factors that influence executive career decisions after departing from organizations affected by environmental pollution.

There are several factors that contribute to the relationship between air pollution and executive turnover. One critical consideration is the extensive impacts of severe air pollution on people's health and well-being.[2] Numerous studies provide evidence that air pollution has adverse impacts on people's mental and physical health, such as shortened lifespan (Chen et al., 2013; Pope et al., 2009; Tanaka, 2015), reduced life satisfaction,[3] and happiness (Levinson, 2012; Li et al., 2014; Luechinger 2009, 2010; MacKerron & Mourato, 2009; Zhang et al. 2017; Zheng et al., 2019), and increased mortality (Chay & Greenstone, 2003; Pope et al., 2011). These health

[1] For example, Xue et al. (2021) documented that the deterioration of air quality in developing nations, has raised significant public concerns and could lead to the migration of highly skilled professionals from those regions, thereby impeding economic growth and development.
[2] Over 50 per cent of the population in the United States resides in counties where levels of either ozone or particle pollution are deemed unhealthy, as reported by the American Lung Association's State of the Air 2016 report.
[3] Especially in China, the lack of progress in life expectancy among residents, despite the significant economic growth experienced over the past thirty years, that can be attributed to the environmental challenges that have arisen (Ebenstein et al., 2015).

implications affect individuals physically and influence their decision-making regarding work location, as they prioritize environments conducive to better health and quality of life.

Moreover, air pollution exerts substantial impacts on the labour and financial markets, which also affect executives' mobility, such as the brain drain effects (Chen et al., 2022; Xue et al., 2021),[4] the behavioural bias of investors and financial analysts (Chang et al., 2018; Dong et al., 2021; Huang et al., 2020; Li et al., 2019;), reduction in individual decision-making efficiency (Dong et al., 2019; Song & Song, 2018), diminished firm productivity and performance (Fu et al., 2017; Li & Zhang, 2019), and decreased economic growth and development around the world (Chen & Chen, 2018; Hanlon, 2016; Li & Zhang, 2019). These broader societal and economic impacts underscore the importance of considering regional air quality as a significant factor influencing executive turnover and subsequent decisions on career path. However, in addition to understanding the impacts of regional air quality, it remains crucial to investigate whether air quality serves as the primary determinant driving executives to change their work and living location. This requires a nuanced analysis that considers various factors influencing executive decision-making, including but not limited to environmental considerations.

Considering the negative impacts of air pollution on people's health and on regional firms, the growing accessibility of real-time air quality information through social media platforms has empowered individuals to make more informed decisions about their living and working locations, for example, some opt to leave heavily polluted areas to reduce their exposure to pollution, especially in China.[5] Therefore, air pollution affects cities' capacity to recruit and retain talent (Xue et al., 2021), especially among highly skilled workers who prioritize better air quality for a higher quality of life, as they have more opportunities to choose where to work and live. In this study, I focus on executives who are increasingly sensitive to air quality concerns (Arntz, 2010). This heightened sensitivity among highly skilled individuals is attributed to their greater awareness of the health and environmental risks associated with living and working in polluted areas, as well as their ability to gather information and make informed decisions about their living and working

[4] Xue et al. (2021) stated that the brain drain hypothesis is that "firms located in more polluted areas in China are less likely to recruit and retain high-quality individuals, leading to a loss of human capital and poor firm performance." (p. 5)

[5] As China's economy has experienced unprecedented growth in recent decades, the ambient air quality has significantly deteriorated to become one of the most severe globally due to heavy reliance on coal-fired energy generation.

arrangements. For example, transnational company executives usually hesitate to work in China due to concerns about air pollution and quality of life (Zheng et al., 2019). Moreover, the effects of migration policies on the costs borne by individuals also vary according to skill level. Local government migration policies often indicate a preference for talented migrants. Individuals with higher levels of education and skills are more likely to obtain hukou status, whereby they gain access to local government-provided services in China and thus benefit from reduced migration costs.[6]

Expanding on this, a natural question is whether executive salaries differ on relocation to a polluted area. Drawing upon the brain drain hypothesis, there are compensation or promotion incentives designed to keep and attract executives who relocate to a polluted area (Dai et al., 2020). The firms located in the polluted areas are paying an "air pollution premium" to the potential managerial talent for bearing environmental and health risks (Hao et al., 2023; Peter & Wagner, 2014; Yang et al., 2022). On the one hand, executives who relocate to polluted areas may demand higher compensation or additional benefits to offset the adverse effects of air pollution on their well-being and quality of life. On the other hand, firms located in polluted areas also increasingly demand highly skilled talent. By exploring the relationship between executive relocation to polluted areas and their corresponding salary differentials, this study aims to shed light on the extent to which firms recognize and compensate for the environmental and health risks associated with such relocations. Understanding whether firms offer an air pollution premium to executives relocating to polluted areas can provide valuable insights into firms' strategies for attracting and retaining managerial talent in challenging environmental contexts.[7]

To investigate the impacts of regional air quality on executive mobility and subsequent salary differences, China is ideal for several reasons. Firstly, China has made remarkable achievements in economic development but has also faced significant challenges regarding air

[6] A significant reform within the hukou system is the implementation of the Talents' Residence Registration System in the 2000s, initially introduced in Shenzhen and Shanghai in 2002 and subsequently expanded to provinces and cities. Under this system, migrants residing in Shenzhen who possess senior professional and technical qualifications, have attained a senior technician technical grade, or hold a master's degree or higher are eligible to apply for and access government-provided services akin to those utilized by local residents (Wei, 2011).

[7] The labor force, especially senior talents, who are the source and driving force of sustained economic growth. As an important factor of production in economic development, so attracting and retaining senior talents is crucial to local economic development.

quality due to rapid industrial activities, urbanization, and higher levels of air pollutants. Severe air pollution issues in many Chinese cities are compounded by factors like heavy coal reliance for energy production, rapid expansion of industrial activities, and burgeoning vehicle ownership.[8] Secondly, there exists significant heterogeneity in the levels of air pollution across geographical regions and over time. For example, urban air in northern China is generally more polluted than in the south. There is also seasonal variation in air quality, with summer and fall being the cleanest seasons. Therefore, substantial cross-regional variation exists in addition to the time-series variation in air pollution, which provides us more statistical power to identify the effects of air pollution in China.

This study examines the hypothesis of poor regional air quality has enduring impacts on executive turnover, thus influencing executives' career paths and choice of workplace in the long term. I use a sample of executives at Chinese A-share companies from 2010 to 2018. Firstly, I obtained the regional air quality index (AQI) from the website of the Ministry of Environmental Protection of the People's Republic of China (MEPC).[9] Then, I assembled data on the career path for all executives in Chinese listed firms from the China Corporate Figure Characteristics Series database (GTA_TMT) in China Stock Market and Accounting Research (CSMAR). I created a unique dataset by tracking executives' work locations combined with their firms' characteristics, including the city where the headquarters of the firm was located before and after the executive's turnover. I excluded the executives who retired as no information was provided after turnover. Lastly, I combined the dataset with the air quality index of the headquarter of the executive's firm

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[8] Haze has increased rapidly in China since the beginning of the 21st century (Gao, 2008). Zhu et al. (2021) stated, "Previous studies have revealed that by the year 2001, the mean annual concentration of total suspended particulate matter (SPM) in the air of China had surpassed the national air quality standard, reaching 200 μg per cubic meter, which was more than double the permissible limit (Chen et al., 2013). Furthermore, in 2003, more than half of China's urban population was subjected to annual levels of particulate matter smaller than 10 μm (PM10) exceeding 100 μg per cubic meter (Cropper, 2010)." (p.1)

[9] The air quality data is publicly in the website of the Ministry of Environmental Protection of the People's Republic of China (MEPC), consists of three sets of air pollution data: (1) Hourly real-time measurements of air pollutant concentrations, following the new standards, for a total of 161 cities; (2) Historical daily values of Air Quality Index (AQI), based on the new standards, starting from January 1, 2014; and (3) Historical daily AQI values according to the previous standards, covering the period from June 5, 2000 to December 31, 2013. The hourly air quality dataset offers comprehensive information on pollutant concentrations obtained from multiple monitoring stations within each city.

before and after relocation and determined the air quality in the headquarters of each firm by using the AQI.[10] It is generally agreed that AQI values above 100 indicate unhealthy air conditions (Li et al., 2021). Therefore, the sample data shows where executives worked before and after turnover, and how the differences in air quality between the two cities.

To investigate the impacts of air quality on executives' choice of working location, I start by exploring whether departing executives are more likely to relocate to cities with better air quality. Consistent with previous studies (e.g., Zhu et al., 2021), I found that executives located in polluted cities are more likely to move to cities with better air quality. This finding suggests that regional air quality is an essential reason for executive turnover and is a crucial consideration for executives when selecting their living and working locations in China.

Then, the study examines how executives' choice of work location affects their compensation. Prior studies suggest that firms located in poorer air quality areas tend to offer a higher wage premium to their executives in order to compensate for undesired environment and quality of life (e.g., Chen et al., 2020; Yang et al., 2022; Zhang et al., 2021). When comparing executives' salaries before and after relocation, and I expected to find that executives who relocated to a polluted area become more sensitive to air pollution than those who migrate to cities with better air quality or stay in the same area, thus more likely to require high compensation for poor working and living environments. However, the empirical results are insignificant when I control for the variables that may affect salaries. Executives who relocated to cleaner or more polluted cities did not receive a different salary.

In the next section, to deal with potential endogeneity problems and strengthen the baseline results, I present several robustness checks, firstly, to test the role of company performance in the relationship between air quality and executive mobility (e.g., Chemmanur et al., 2014). According to previous studies (e.g., Chang et al., 2014; Chang et al., 2016), poor regional air quality may lead to worse company performance, which increases the likelihood that executives are dismissed (Denis & Denis, 1995; Jenter & Kanaan, 2015; Kato & Long, 2006) and increase executive turnover (Chang et al., 2016; Zivin & Neidell, 2012). I used ROA and Tobin's Q to represent

[10] According to MEPC, air pollution in general increases in AQI according to the following seven categories:(1) Excellent (air quality) when AQI is under 50; (2) Good for AQI between 50 and 100; (3) Slightly polluted for AQI between 101 and 150; (4) Lightly polluted for AQI between 151 and 200; (5) Moderately polluted for AQI between 201 and 250; (6) Heavily polluted for AQI between 201 and 250; (7) Severely polluted for AQI above 300.

company performance and found that there is no significant relationship between executive mobility and company performance. The results show that good company performance would not help firms to retain executives or mitigate the brain drain effects. This finding further suggests that regional air quality plays a more significant role in executive career path decisions than firm performance.

Then, I use alternative ways of measuring air pollution to verify the robustness of the results. I classified the AQI of the executive's city before relocation, into four groups: 0-50, 50-100, 100-150, and 150-200. However, the shortcoming of this test is that the sample data concentrated on the groups of 50-100 and 100-150. Even if there are data limitation, the results provide further evidence that poorer air quality affects executive mobility and executives are more likely to relocate to cities with better air quality.

Next, I use a regression discontinuity design (RDD) to exploit discontinuous variation in air pollution created by China's heating policy to establish causality more rigorously (Almond et al., 2009; Chen et al., 2013).[11] China's central government provided coal-based heating for cities north of the Huai River, which generated substantially higher pollution levels in the northern cities. According to Hao et al. (2023), China's central heating policy creates a discontinuity in AQI for cities located on the two sides of the Huai River, thus affecting new CEO compensation and promotion. Therefore, I tested whether executives' choice of work location or career path differs between northern and southern China. The result is consistent with the previous results, which confirm that air pollution and executives' mobility show discontinuous jumps across the QH boundary.

Finally, I conduct a test to compare the impacts on state-owned listed companies (SOEs) and non-state-owned listed companies (non-SOEs). Consistent with Zhu et al. (2021), I find that departing executives at non-SOEs are more likely to relocate to cities with better air quality. This is because they have more flexibility to change their work and move to other work locations than those at state-owned listed companies. Based on the above evidence, I believe that there is a significant relationship between regional air quality and executive mobility. Air quality has a direct impact on executives' choice of work and place of living location.

[11] During the central planning period from the 1950s to the 1980s, China implemented a heating policy known as the Huai River policy, in which the Qinling Mountains and the Huai River (QH boundary) were utilized as a geographical demarcation line between northern and southern regions.

This study contributes to the existing literature in several ways. First, it contributes to the literature examining the effects of air pollution on human capital. Following the brain drain hypothesis, while previous research has extensively studied the effects of air quality on turnover at individual and firm levels in the short term, less attention has been given to examining how air quality influences executives' choices regarding work location and career paths after turnover in the long term. Given the importance of regional air quality in retaining highly skilled people for firms, this thesis attempts to extend studies by exploring these aspects. Consistent with prior literature findings, this paper documents that departing executives located in polluted areas are more likely to relocate to cities with better air quality. In addition, understanding the factors of choosing a desirable location for a firm's headquarters is important, as it has the benefit of attracting senior talents and increasing the stability of human capital in the long term. Therefore, comparing with previous literature solely focused on the short-term effects, this study provides a more comprehensive understanding of the long-term relationship between regional air quality and executive turnover. The results could contribute to the decision-making processes related to the choice of location of firms' headquarters, talent retention strategies, and environmental regulations.[12]

Second, this thesis presents empirical evidence contributing to the existing executive compensation literature. While previous research has primarily focused on the impact of firm financial situations (Firth et al., 2006), corporate governance (Ang et al., 2000; Zheng et al., 2012), executive characteristics (Hill & Phan, 1991; Li et al., 2015), and other factors influencing executive compensation, our paper investigates how executive mobility is influenced by regional air pollution and its subsequent effects on compensation received by departing executives in the areas with different pollution level. Consistent with Zhu et al. (2021), higher executive compensation does not mitigate the effects on executive's turnover, thus consequence of turnover not related to their future compensation. Prior literature support that provides monetary compensation is a strategy to retain talent and mitigate the negative impacts of the brain drain effects in the polluted areas (Levine et al., 2018; Xue et al., 2021; Yang et al., 2022; Zhu et al.,

[12] For example, in 1998, the Chinese government implemented stringent regulations on pollutant emissions from power plants, marking one of the initial large-scale attempts in developing countries. This policy, known as the Two Control Zone (TCZ) policy, identified approximately 175 prefectures that exceeded nationally mandated pollution standards as TCZs.

2021; Zhang et al., 2021). However, the findings highlight that air pollution considerations may outweigh salary differences when executives decide their work and living locations. In addition, the size of the original and destination firm may have more impact on executives' compensation, which is consistent with Gabaix and Landier (2008). They conclude that managers who work for larger companies would receive higher salaries because of more growth potential and then ignore the effects of air pollution on their life. Thus, this study not only extends the literature on the brain drain hypothesis but also emphasizes the importance of other factors influences on executives' salaries for example, growth potential of a firm or economic development of a city.

Third, the conclusion of this paper shows that regional air quality not only inhibits the accumulation of highly skilled talents but also affects the benefits and costs of regional agencies and governments. For example, the government could improve regional air quality to retain and attract managerial talents and reduce the labour costs for local companies. This study provides empirical evidence for environmental agencies to enhance the ability of air quality management to foster economic growth in the long term. This investigation can shed light on the potential consequences of regional air quality on the stability, performance, and long-term sustainability of businesses and organizations. Understanding the impact of air quality on executive turnover can have practical implications for organizations, policymakers, stakeholders and healthcare systems. It can help inform decision-making processes regarding location choices, talent retention strategies, and environmental regulations. Such insights are essential for policymakers and businesses alike in devising strategies to mitigate the negative impacts of air pollution on executive talent retention and overall economic development. Understanding these dynamics can aid policymakers and businesses in developing strategies that promote healthier environments and reduce medical cost while also considering the needs and preferences of executives who play crucial roles in driving economic growth and development (Deryugina et al., 2019).[13] Furthermore, it contributes to the growing body of knowledge on the intersection of environmental factors and executive behavior, providing a deep understanding of how environmental conditions can affect leadership and management within companies.

[13] There is a need to further explore and identify the effects of air pollution on healthcare expenses at the individual level in China.

The thesis is closely related to the study by Zhu et al. (2021), who also investigated the impacts of air pollution on executive turnover. However, it differs from Zhu et al. (2021) in two ways. First, this paper utilizes a unique dataset by tracking executives' work locations before and after turnover, which is then merged with the regional air quality index, while their paper focuses on whether air pollution affects executive turnover without subsequent defensive behaviour of air pollution. Thus, the dataset helps to create a more complete picture of the relationship between regional air quality and executive turnover. Second, this thesis aims to explore the prolonged influence of air pollution on executives rather than solely examining the short-term impacts thereby addressing a gap in the existing literature by considering long-term costs to labour, firms, and regions.

The remainder of the paper is organized as follows. Section 2 describes the literature review and hypothesis development. Section 3 describes the data sample sources, method of collection and merger data, and the measurement of variables. Section 4 describes the empirical approach, including main variables and empirical model specification. Section 5 presents the two main empirical results on the impacts of regional air quality on executives' mobility, and the effects on executives' salaries. Section 6 reports the robustness of the main empirical results, including the role of company performance, alternative ways of measuring air quality, regression Discontinuity (RD) methodology based on the Huai River policy to examine the effect of air pollution on executive career mobility and salary difference, and the different impacts on SOEs and non-SOEs. Section 7 concludes the paper.

2. Literature Review and Hypothesis Development

2.1 Regional Air Quality and Executive Turnover

The adverse effects of air pollution on various aspects of human life have been extensively examined in academic literature across economics, environmental science, and medicine. Prior research has provided substantial evidence illustrating the profound impact of regional air quality on individuals' physical and mental well-being, as well as its implications for human capital retention and corporate performance, thereby influencing decision-making regarding turnover and workplace selection. Medical studies have demonstrated the detrimental consequences of air pollution on health conditions, including increased risks of heart disease (Dominici et al., 2006) and lung cancer (Nyberg et al., 2023), thus shortened life span (Chen et al., 2013; Pope et al., 2009;

Tanaka, 2015), increased children's respiratory health problems (Jans et al., 2018), and elevated mortality rates (Chay & Greenstone, 2003; Pope et al., 2011). Anderson (2020) further established a link between long-term exposure to air pollution and heightened adult mortality. In the context of China, Fan et al. (2020) highlighted the contribution of the winter heating system to heightened air pollution levels and subsequent mortality rates.[14]

Beyond physical health, studies such as Fotourehchi (2016) highlighted not only the direct physical health damage caused by air pollution but also the significant indirect impact on mental health risks. Prior research has demonstrated the adverse effects of air pollution on neurological functioning and cognitive performance (Lavy et al., 2014; Power et al., 2011; Suglia et al., 2008; Weuve et al., 2012;), leading to decreased life satisfaction and happiness (Levinson, 2012; Li et al., 2014; Luechinger, 2009, 2010; MacKerron & Mourato, 2009; Zhang et al., 2017).

Given that health constitutes a significant component of human capital, the heightened risks to physical and mental well-being may impact decision-making and subsequent behaviour in financial markets (Chang et al., 2016; Chang et al., 2019; Dong et al., 2021; Lavy et al., 2014; Molina, 2021; Zivin & Neidell, 2012).[15] In addition, people's negative mood can be induced by air pollution (Bakian et al., 2015; Heyes et al., 2016; Hu et al., 2014; Huang et al., 2020; Li et al., 2020), thereby affecting productivity (Fu et al., 2021) and overall performance.[16] For example, Zivin and Neidell (2012) revealed a significant reduction in worker productivity in response to pollution levels below federal air quality standards. Chang et al. (2016) demonstrated how PM2.5 adversely affected the productivity of indoor workers.[17] According to the brain drain hypothesis,

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[14] These hazards mainly stem from alterations in lung and heart function (Seaton et al., 1995). While high levels of exposure (or lower levels for those who are more vulnerable) can lead to significant health issues, even slight exposure levels can affect an employee's efficiency because of fluctuations in blood pressure.

[15] Considering the higher health risks faced by labour due to severe air pollution, existing research has extensively investigated the effects of air pollution on various aspects, including labour productivity (Zivin & Neidell, 2012), analyst forecasts (Dong et al., 2021), corporate innovation (Luo et al., 2019).

[16] In their papers, Ebenstein et al. (2016) and Chang et al. (2019) provide evidence of the negative impacts of severe exposure to air pollutants on students' exam performance, and call-centre workers' performance, respectively.

[17] PM 2.5, also known as "fine" particles,. Because of these particles with a diameter of less than 2.5 μm, which can deposit in people's lungs and cause significant health risks. Before 2013, PM 2.5 concentration was not measured separately from other particulate matters when constructing an AQI. Beginning in January 2013, MEPC adopted a new set of air quality standards, the

Xue et al. (2021) suggest that severe air pollution has a negative influence on a firm's human capital and overall performance. Therefore, firms operating in cities with poor air quality are more likely to reduce their R&D and innovative output (Luo et al., 2019), dismiss workers (Jenter & Kanaan, 2015), experience increased forced turnover (Kato & Long, 2006; Zhu et al., 2021) because of poor corporate performance.

Consequently, these are heightened risks to mental and physical health, brain drain effects, and declining performance, which may contribute to voluntary departures for executives. Individuals may opt for relocation as a defensive strategy to mitigate the adverse effects of severe air pollution (e.g., Deschenes et al., 2017; Hanna & Oliva, 2015).[18] For instance, Chen et al. (2017) and Qin and Zhu (2018) provided evidence on the impact of air pollution on migration in China. However, the feasibility of relocation varies, and empirical evidence suggests that migration may not be suitable for everyone (e.g., Banzhaf & Walsh, 2008). Notably, higher-level executives, who possess advanced education and skills and are higher-income earners (Black & Lynch, 1996),[19] are more likely to engage in voluntary turnover. Moreover, these health problems also have a more pronounced effect on executives, who face elevated stress and responsibility. Zhang et al. (2021) further demonstrated that executives tend to prioritize quality of life after meeting their basic living needs, which underscores their sensitivity to air pollution and heightened expectations for quality of life.

In light of executives' enhanced ability to migrate and their heightened concerns regarding work and living environments, recent studies have investigated the relationship between air pollution and executive turnover. For example, Levine et al. (2018) observed that firms experienced increased CEO turnover following the opening of a nearby toxic plant. Zhu et al. (2021) provided further support that poor air quality led to executives changing work locations

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published AQI further includes fine particulate matter smaller than 2.5 micrometers (PM2.5), CO, and O3.

[18] People facing poor air quality can adopt defensive behaviours to prevent exposure to air pollution. If provisional defensive behaviours cannot assure health or are too costly in the long run, people will ultimately seek to settle in areas with better air quality. Nevertheless, not everyone has the flexibility to "vote with their feet." We expect this individual sorting effect to be more salient among skilled workers (Xue et al., 2021).

[19] According to the hukou system in China, for example in Shanghai, migrants who had completed a bachelor's or higher degree or as a special talent could obtain local hukou status. They are eligible to gain access to Shanghai government-provided services, which save their migration costs (Xue et al., 2021).

because they had more concerns about exposure to polluted air in the long term as tenure increased. However, relocation is a long-term and costly behaviour.[20] Hao et al. (2023) noted that while CEO turnover is more prevalent in firms located in polluted areas,[21] some executives may opt to relocate to more polluted regions, contingent on compensation to offset the adverse effects on health and quality of life.

In sum, I argue that poor regional air quality may affect executives' health and performance. Thus, executives who live in polluted areas are more willing to migrate to less polluted cities after departing their original firm. Based on the above reviews, the first hypothesis is as follows:

Hypothesis 1 (H1): Departing executives located in polluted areas are more likely to relocate to cities with better air quality.

2.2 Executive Mobility and Compensation

Consistent with our argument in the hypothesis development, deteriorating air quality prompts top managers to resign and potentially relocate to another city with a more desirable environment (Lu et al., 2018; Qin & Zhu, 2018; Zhu et al., 2021). Therefore, the consequence of air pollution inevitably alters the equilibrium of local executive labour markets. The adverse effects of air pollution on the attractiveness of certain locales can trigger a talent migration phenomenon, thereby increasing the demand for managerial talent in polluted areas and subsequently exerting upward pressure on executive compensation (Gao et al., 2015). Given the shortage of managerial talent, Zhang et al. (2021) mentioned the necessity for executive compensation contracts to not only mitigate conflicts of interest between shareholders and executives but also to adapt continuously to prevailing circumstances.

From the perspective of executives, their concerns shift towards quality of life once basic living needs are met, particularly as managerial roles typically command higher earnings than those of regular employees. Therefore, executives often strive to strike a balance between non-monetary and monetary rewards to maximize their utility (Zhang et al., 2021). As previously

[20] In the short to medium term, most people prefer to purchase facemasks (Zhang & Mu, 2018), or air purifiers (Ito & Zhang, 2020).

[21] Executives also possess greater financial capacity to relocate to cities with better air quality, as reflected in housing prices (Chay & Greenstone, 2005). Additionally, they have more knowledge about the harmful effects of air pollution and exhibit lower tolerance for poor air quality. They may also have access to more information about job opportunities and face lower costs when searching for new positions (Arntz, 2010).

discussed, section that air pollution heightens executives' health risks and diminishes their quality of life, thereby reducing their non-monetary returns. In return, executives request a pollution pay premium as part of their monetary compensation. Yang et al. (2022) further supports that firms in locations with bad air quality tend to pay higher monetary compensation to their executives than firms located in less polluted areas to maintain utility levels. Moreover, the increased medical expenses are influenced by the adverse impacts of escalating air pollution on health, such as increased hospital costs or a heightened probability of hospitalization. Companies need to increase monetary compensation to maintain their executives' current utility levels and cope with the associated rise in medical expenses. In contrast, some studies mention that compensation may not significantly impact executives from high-income groups (Deng & Gao, 2013) because monetary compensation is less attractive for senior executives with higher qualifications as they are already earning higher pay (Zhang et al., 2021), or those with long tenure (Zhu et al., 2021).

From the perspective of corporations, Roback (1982) and Myers (1987) posit that companies in less liveable regions may offer higher salaries to retain equally qualified employees and attract proficient senior managers. Failure to adjust monetary compensation could lead to decreased work efficiency and overall performance, prompting highly skilled talent to migrate elsewhere. Recently, Hao et al. (2023) also emphasized the importance of compensation or promotion incentives for CEOs in preserving executive stability amidst air pollution challenges. However, the compensation premium offered by listed companies is influenced by their bargaining power, which in turn impacts their motivation and ability to pay. In industries with higher levels of competition, the demand for senior talent increases while available talent pool becomes limited. As a result, companies experience weaker bargaining power and exhibit stronger motivation to pay a premium due to air pollution (Zhang et al., 2021).

Despite adverse environmental conditions, CEOs may still accept offers from polluted areas if firms adequately compensate for health risks, thus offsetting their living costs. This phenomenon highlights the importance of air quality as a crucial determinant of executive mobility and its subsequent implications for executive compensation in competitive labour markets.

Consequently, executives who relocate to areas with poorer air quality may receive more attractive compensation packages, where the pollution pay premium offsets the adverse effects of health and living risks induced by regional air pollution. Hence, the second hypothesis is formulated as follows:

Hypothesis 2 (H2): Departing executives who relocate to more polluted areas may receive higher compensation.

3. Data and Sample

Following Li et al. (2020), Li et al. (2021), Dong et al. (2021), Zhu et al. (2021), and Yang et al. (2022), I use the AQI as the primary measure of air quality significantly shaping the decision-making processes of residents in Chinese cities. Prior research underscores the high accuracy of forecasted AQI values (Song et al., 2019). The air quality data utilized in this study were obtained from the website of the Ministry of Environmental Protection of the People's Republic of China (MEPC), encompassing AQI from 338 cities at and above the prefectural level.

In 2000, the Ministry of Environmental Protection (MEP) initiated the daily publication of an Air Pollution Index (API) for major cities in China. Prior to 2014, the Chinese government solely monitored sulfur dioxide (SO2), nitrogen dioxide (NO2), and suspended particulates smaller than ten μm in aerodynamic diameter (PM10), which were utilized to construct the API as a comprehensive measure of air quality during earlier years. Given the rapid increase in haze since 2000 (Gao, 2008), China implemented a program to enhance real-time monitoring of primary pollutants and commenced publishing an updated real-time AQI on the Ministry of Environmental Protection (MEP) website starting from January 1st, 2014. The website of MEPC now offers a wide range of air pollution data necessary for constructing AQI that caters to researchers, policymakers, and the general public's needs. These datasets offer hourly measurements for six major air pollutants - SO2, NO2, CO, O3, PM10, and PM2.5. These measurements are collected by a network consisting of 1701 local stations with an aim to provide deeper insights into air quality trends and facilitate informed decision-making processes. While the API and AQI are not directly comparable, they are highly correlated (Zheng et al., 2014). Integrate the API and AQI to establish a comprehensive indicator that reflects the level of air pollution and associated health risks. The Air Quality Index (AQI) is scored on a scale of 0 to 500, where a higher AQI value denotes more severe pollution levels.

To investigate the impacts of regional air quality on executive mobility in China, I needed to obtain both regional air quality information and data on executive, firm, and city characteristics. Specially, data on executives, firms, cities, and the classification of industry are sourced from the China Stock Market and Accounting Research (CSMAR) database, encompassing the size, leverage, profitability, asset growth rate, and type of ownership of each firm, and Tobin's Q; executive gender, age, degree, and compensation; and city-level gross domestic product (GDP). However, the CSMAR lacks detailed information on executives' career paths, including the firms and cities executives migrate to. To address this gap, I manually collected executives' origin and destination information by sorting their Person IDs. Executives' working experience is often documented under their Person ID, with changes in Stkcd indicating executive turnover. Consequently, I then recorded the Stkcd of the original and final firms, along with the timing of executive departures and arrivals, facilitating the integration of firm characteristics and the regional air quality index.

A significant concern arises from incomplete information on executives after turnover in the CSMAR. This can be attributed to two primary reasons. Firstly, executives typically have longer tenure than other employees. For example, there is limited information available on retired executives as they do not have subsequent career paths. Secondly, not all firms disclose executives' personal information publicly, thus there is limited executive information in the CSMAR. Consequently, the dataset's shortfall in missing or limited data may impact the accuracy and reliability of empirical findings in this study. To address this, future research endeavours may involve aggregating data from multiple sources, such as utilizing company websites or external resources, to complement the primary data sources like CSMAR. In this way, mitigating the impacts of missing data by reducing occasionality and using a larger data sample would increase the accuracy and reliability of empirical results. The initial sample comprises the career paths of 467 executives who experienced turnover from 2010 to 2018 in China. Following the verification of all control variables, the final sample consists of 401 executives who experienced relocation.

4. Empirical Approach

4.1 Main Variables

In this section, I describe the variables utilized to assess the proposed hypotheses. First, I introduce the independent variable, ln_AQI1, which is the natural logarithm of AQI in the city where the executive lived before turnover. A higher ln_AQI1 means worse air quality in cities where executives are located before turnover, reflecting less desirable living and working conditions. As a robustness check, I also use four alternative measures of air quality, which are four dummy variables that are equal to I if the original AQI is between 0 and 50 (AQI1 0-50), between 50 and 100 (AQI1 50-100), between 100 and 150 (AQI1 100-150), and between 150 and 200 (AQI1 150-200), and 0 otherwise.

Next, I describe the primary explanatory variables. ΔAQI, which represents the difference of AQI between the cities where executives' firms were located before and after turnover, is calculated as origination AQI minus destination AQI. This variable allows for a comparison of regional air quality before and after turnover, shedding light on executives' decisions regarding work locations or career paths. Then I create three indicators: ΔAQI>0 equal to 1 if AQI for the original city is greater than the destination AQI, and 0 otherwise. In other words, ΔAQI>0 means the executive relocated to a less air polluted area; ΔAQI<0 is equal to 1 if the original AQI is less than the destination AQI, and 0 otherwise, which means the executive relocated to a more polluted area; ΔAQI=0 is equal to 1 if the original AQI is equal to the destination AQI, and 0 otherwise, implying the executive's decision to stay in the same area. This thesis aims to ascertain whether departing executives relocated to cities with better air quality.

Subsequently, I move on to describe the executives' salaries received before and after turnover. To test H2, I create the variable, Salary Difference, which is equal to a departing executive's total salary after turnover minus their total salary before turnover in a year. For example, if an executive migrates to a more polluted area, a positive salary difference is expected as compensation for the undesired working and living environment.

4.2 Empirical Model Specifications

Following the prior literature, I present the methodology employed to examine the impacts of regional air quality on executive mobility. Firstly, I utilize logistic regression models on pooled cross-sectional data to assess the relationship. The model (1) is formulated as follows:

$$\Delta AQI > 0_{t+1} = a_0 + a_1 ln\_AQI1_t + \sum a_n Controls_{i,t} + \varepsilon_{i,t} \quad (1)$$

Where ΔAQI > 0 is a dummy variable, which is equal to 1 if departing executives migrate to the city with better air quality, and 0 otherwise. The independent variable, ln_AQI1, which is a continuous variable equal to the natural logarithm of AQI for the city where the executive was located before relocation. To address potential endogeneity concerns, a lag value of the independent variable is utilized. Subscripts i and t refer to firm i and year t, respectively. To test H1, I expect that $a_1 > 0$, which means there is a positive and significant relationship between ln_AQI1 and ΔAQI > 0, represents that executives who are located in more polluted areas are more likely to relocate to cities with better air quality.

Following the previous literature (Dai et al., 2020; Deng & Gao, 2013; Focke et al., 2017; Jenter & Kanaan, 2015; Levine et al., 2018; Sun et al., 2019; Zhu et al., 2021), first, I control for a series of firm-specific characteristics in this model.[22] Size is measured by the natural logarithm of the total assets of the company in a year. Leverage is measured by total liabilities divided by total assets. ROA is measured by net income divided by total assets. Growth is the growth rate of the total assets of the company in the current year. ln_Boardsizes is defined as the natural logarithm of the total number of directors of the company in a year. ln_Capexp is the natural logarithm of the capital expenditures. ShareRatio is the shareholding ratio of a company's executives. ln_Top3Salary is measured by the natural logarithm of the sum salary for the top three managers in a year.

Moreover, the city characteristic, ln_GDP, is measured by the natural logarithm of the GDP of the province where a listed company operates in the current year to control the difference in economic development and inflation. The executive characteristics include Age, Gender, and Degree. Age is the firm i's executive age in year t. Gender is a dummy variable that is equal to 1 if the executive is male and 0 otherwise. Degree is defined by seven types: 1 (secondary school and below), 2 (junior college), 3 (undergraduate), 4 (master's degree), 5 (doctoral degree), 6 (other published in other forms, such as honorary doctorate, correspondence, etc), and 7 (MBA/EMBA). Following Du and Peng (2017) and Zhang et al. (2021), using executives' education background to measure executive bargaining power. Senior executive talents are more bargaining power than low-skilled talents because they have more job opportunities in the labour market (Zhang et al., 2021).

Considering the unobservable factors related to industry and unobservable effects from industry types may affect regional air quality and executives' decisions on working location or career path. In order to mitigate potential endogeneity, this paper controls for the industry-fixed effect and year-fixed effect.

Furthermore, to investigate the consequences of executive turnover and the role of compensation, I conduct a regression analysis of the pooled cross-sectional data using model (2):

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[22] Those variables ending in "1" represent origination (before turnover) variables and those ending in "2" represent destination (after turnover) variables.

$$\boldsymbol{Salary\ Difference}_{t+1} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1}\Delta \boldsymbol{AQI}_{t+1} + \sum \boldsymbol{\beta_n Controls_{i,t}} + \boldsymbol{\varepsilon_{i,t}} \tag{2}$$

Where ΔAQI is measured by ΔAQI > 0, ΔAQI = 0, and ΔAQI < 0, which are defined as above. Salary Difference is the dependent variable, which is a continuous variable equal to total salary after turnover minus total salary before turnover. When testing H2, I expect that a negative coefficient ($\beta_1 < 0$) for ΔAQI > 0 or a positive coefficient ($\beta_1 > 0$) for ΔAQI < 0 would suggest that there are significant differences in executives' salaries between executives who relocate to less polluted areas and those who relocate to more polluted areas.

Following existing research (Deng & Gao, 2013; Jiang et al., 2014; Xin et al., 2007; Chen et al., 2022), I control for several other variables that may affect executive compensation in the model (2), which are same as the control variables in model (1). Industry and year fixed effects are included in model (2) to control for the industry- and year-specific characteristics.

5.Empirical results

This section presents the empirical findings of my study, which begins by examining the influence of regional air quality on executive mobility in terms of their choice of working location and career trajectory. Subsequently, it investigates the role of compensation in relation to executives' decisions regarding their working location and potential salary disparities. Finally, a series of robustness checks and additional tests are presented.

5.1 Descriptive Statistics

Table 1 presents descriptive statistics of the sample and variables in this study. The descriptive statistics in Panel A provide an overview of environmental variables related to executive mobility between January 2010 and December 2018. The environmental variable of interest, ΔAQI, represents the difference between the AQI of the city where the executive was located before turnover and the AQI of the city where the executive is relocating after turnover. In my sample, 188 executives relocated to a less polluted area (ΔAQI > 0), which the relocation is nearly balanced distribution of 190 executives relocated to a more polluted area (ΔAQI < 0). The mean of executives who relocated to cities with poorer air quality is 0.407, which is higher than those who moved to cities with better air quality or who moved to cities with similar air quality. The results are consistent with Hao et al. (2023), who also documented that more executives relocated to more polluted areas. For example, their study mentioned that almost 20.60% of CEOs who moved to Beijing had come from a less polluted area. There are two possible reasons. One is that executives who migrate to a polluted area may have more opportunities (e.g., Beijing) as they have more concerns about career development than environmental conditions. Another reason is that they may receive higher compensation, which offset the costs of living in an undesirable area.[23] Panel B of Table 1 presents descriptive statistics for firm and city variables, both at the origination (before turnover) and destination (after turnover) of executive mobility. In this sample, the mean of ln_AQI is 4.372 in the original cities, which is higher than in the final cities 4.369, which means the air quality of the executive's destination cities is better than in their original cities. Furthermore, I conduct the mean variance tests to investigate whether there are significant differences between the origination and destination of executives located before and after turnover. The results show that the two sub-samples have no significant differences in ln_AQI. However, positive significant differences are seen in executive salary (ln_TotalSalary and ln_Top3Salary), which means salary plays a significant role in executives deciding their work location. Panel C reports descriptive statistics for executive variables. Expectedly, the mean of executive degree is 3.823, showcasing a high level of academic achievement, which is between an undergraduate and master's degree, suggesting that executives have more bargaining power.

Table 2 presents the Pearson correlation matrix to examine the linear relationship between ΔAQI, firm and executive characteristics. Those variables ending in "1" represent origination (before turnover) variables, and those ending in "2" represent destination (after turnover) variables. Consistent with H1, the results show a significantly positive relationship between $\Delta AQI > 0$ and ln_AQI1 at the 1% level, which demonstrates that departing executives are more likely to work in a city with better air quality if they came from a more severely polluted area. In addition, there is a significantly positive correlation between ln_AQI1 and ln_GDP1 at the 5% level, which signifies the more polluted cities may generate higher GDP in a year, thus there have more potential opportunities and develop in a growing way. This finding suggests that executives who relocated to more polluted areas for future career development. In addition, growth has a significant positive correlation with $\Delta AQI < 0$, suggesting that firms in areas of increased pollution may still be experiencing asset growth, which is consistent with previous evidence.

[23] Xue et al. (2021) mentioned that "According to a study conducted by the ChinaHR Research Institute in 2018. The top Chinese cities in which people intend to work include Beijing, Shanghai, Guangzhou, Hangzhou, Shenzhen, Chengdu, Wuhan, Tianjin, Nanjing, Xian, Chongqing, Jinan, Zhengzhou, Changsha, and Shenyang" (p. 7).

Table 1

Descriptive statistics.

Panel A: Environmental variables

	N	mean	sd	min	max
ΔAQI > 0	188	0.403	0.491	0	1
ΔAQI = 0	89	0.191	0.393	0	1
ΔAQI < 0	190	0.407	0.492	0	1

Panel B: Firm and city variables

	Origination (before turnover).					Destination (after turnover)					
	N	mean	sd	min	max	N	mean	sd	min	max	MeanDiff
ln_AQI	467	4.372	0.262	3.686	4.995	467	4.369	0.268	3.745	5.448	0.003
Leverage	467	0.475	0.306	0.049	4.588	467	0.490	0.230	0.030	1.292	-0.015
ROA	467	0.022	0.126	-1.300	0.393	467	0.017	0.101	-1.016	0.381	0.005
Growth	467	0.247	0.632	-0.601	7.492	467	0.191	0.631	-0.767	7.585	0.056
Q	439	3.612	6.386	0.765	127	440	2.387	2.543	0.803	27.340	1.225
Size	467	22.330	1.628	17.390	30.760	467	22.35	1.724	18.070	30.450	-0.018
ln_GDP	467	9.044	1.070	5.545	10.550	467	9.038	1.044	5.308	10.550	0.006
ln_TotalSalary	409	13.270	0.714	11.060	16.030	407	12.950	0.762	10.780	15.450	0.322***
ln_Capexp	465	18.410	2.131	9.876	24.760	463	18.380	2.218	9.248	24.290	0.028
ln_Top3Salary	467	14.570	0.766	12.130	16.790	462	14.360	0.832	9.038	17.040	0.205***
ln_MV	432	23.080	1.330	20.790	30.730	440	23.030	1.426	20.380	30.450	0.050
SOE	456	0.081	0.273	0	1	454	0.123	0.329	0	1	-0.042**
ShareRatio	454	11.090	18.390	0	87.750	452	7.857	15.590	0	74.860	3.236***
ln_Boardsize	467	2.126	0.214	1.386	2.890	467	2.134	0.233	1.609	3.045	-0.008

Panel C: Executives variables

	N	mean	sd	min	max
Gender	465	0.837	0.370	0	1
Degree	417	3.823	0.918	2	7
ln_Age	465	3.805	0.146	3.367	4.190

Notes

*, ** and *** indicate the significance at the 10%, 5%, and 1% levels, respectively.

5.2 The Impact of Regional Air Quality on Executive Mobility

I begin the empirical analysis by estimating Model (1) to investigate the impact of regional air quality on executive mobility. The purpose of this test is to understand the importance of regional air quality in executives deciding their work and residential location, and to determine to what extent it affects executives' mobility and career path. The main explanatory variable, ln_AQI1, is measured by the natural logarithm of AQI for the city where the executive was located before turnover. The dependent variable is $\Delta AQI > 0$, which is a dummy variable that is equal to 1 if the departing executive relocated to a city with better air quality, and 0 otherwise.

Table 3 presents the ordinary least squares regression results of the impacts of origination air quality on executive choices of working location. In column (1) of Table 3, I find that the coefficient of ln_AQI1 is 0.723, which is positive and significant at the 1% level. When I add the control variables of the origination and destination in columns (2) and (3), respectively, the coefficient is still significant at the 1% level, thus the air quality of the city where executives were located before turnover is more important than the firm and city factors. These results demonstrate that departing executives who work in a polluted area are more likely to relocate to cities with better air quality. In addition, when I add the city fixed effect to the model in column (4), the result is also significant at the 5% level and provides further support to H1. Insignificant coefficients for Size2 and ROA2 in models (3) and (4), indicate that post-turnover firm characteristics are not decisive factors for executives' relocation due to air quality concerns.

However, ln_GDP2 shows a significant and negative relationship with $\Delta AQI > 0$, with coefficients of -0.083 and -0.102 in models (3) and (4), respectively. Consistent with Shen et al. (2019), there is no relationship between air quality and regional economic development. This finding suggests that departing executives are less likely to migrate to an area with a lower GDP, even if air quality improves. Therefore, future research might focus on how to achieve a balance between environmental concerns and future career opportunities and development. Also, the adjusted R-squared from 0.142 in model (2) to 0.177 in model (4), indicates a better fit of the model when controlling for these additional factors.

These findings demonstrate that regional air quality plays a crucial role in executives' decision- making about work location. Thus, the impact of air quality on executive mobility has significant implications for both individuals and regions. Specifically, this study highlights the brain drain effects from local environmental and economic conditions, emphasizing that with poor

Table 2

Pearson correlation matrix.

	ΔAQI > 0	ΔAQI = 0	ΔAQI < 0	ln_AQI1	ln_AQI2	Leverage1	ROA1	EPS1
ΔAQI > 0	1							
ΔAQI = 0	-0.397***	1						
ΔAQI < 0	-0.654***	-0.434***	1					
ln_AQI1	0.376***	0.019	-0.385***	1				
ln_AQI2	-0.359***	-0.011	0.362***	0.421***	1			
Leverage1	-0.002	-0.002	0.004	-0.041	-0.044	1		
ROA1	0.069	-0.157***	0.062	0.043	0.061	-0.289***	1	
EPS1	-0.039	-0.113*	0.131**	0.028	0.079	-0.058	0.570***	1
Growth1	-0.059	-0.105*	0.144**	-0.078	-0.053	-0.079	0.107*	0.114*
Q1	-0.036	0.006	0.031	0.033	0.066	0.008	0.038	-0.134**
Size1	0.019	0.09	-0.093	0.122**	0.041	0.343***	0.077	0.399***
ln_GDP1	0.033	0.194***	-0.192***	0.149**	0.048	-0.014	-0.017	0.047
ln_DepTotalSalary	0.064	0.064	-0.115*	0.079	-0.014	0.055	0.124**	0.318***
ln_Capexp1	-0.005	0.064	-0.047	0.008	0.035	0.182***	0.136**	0.348***
ln_Top3Salary1	0.016	0.061	-0.066	0.038	-0.043	0.069	0.083	0.317***
ln_MV1	0.025	0.105*	-0.111*	0.175***	0.077	0.352***	0.104*	0.397***
Nature1	0.046	0.007	-0.052	0.005	-0.032	0.097	0.021	0.097
ShareRatio1	0.018	-0.071	0.041	-0.098*	-0.018	-0.230***	0.008	-0.082
ln_Boardsize1	-0.007	0.094	-0.07	0.012	-0.05	0.174***	-0.013	0.034
Leverage2	0.056	-0.07	0.003	-0.118**	-0.115*	0.205***	0.082	0.107*
ROA2	-0.049	0.045	0.011	0.07	0.031	-0.04	-0.022	0.018
eps2	-0.088	0.049	0.046	0.001	0.012	0.022	0.063	0.243***
Growth2	-0.119**	0.055	0.072	-0.042	0.08	-0.051	-0.045	0.053
Q2	0.055	-0.012	-0.044	0.093	0.005	0.03	-0.012	-0.087
ln_asset2	0.037	-0.063	0.015	-0.036	0.031	0.148**	0.037	0.223***
ln_GDP2	-0.136**	0.154***	0.006	0.006	0.151**	-0.007	-0.042	0.041
ln_DestTotalSalary	0.038	-0.023	-0.019	0.013	-0.008	0.039	0.096	0.251***
ln_Capexp2	0.077	-0.006	-0.071	-0.025	-0.078	-0.004	-0.018	0.119**
ln_Top3Salary2	0.012	0.017	-0.026	-0.058	-0.072	0.04	-0.012	0.131**
ln_MV2	0.07	-0.066	-0.015	0.021	0.062	0.152**	0.04	0.204***
Nature2	0.004	-0.046	0.034	0.067	0.147**	-0.053	0.047	-0.025
ShareRatio2	-0.013	0.087	-0.059	0.102*	-0.007	-0.075	-0.038	-0.085
ln_Boardsize2	-0.023	-0.085	0.093	0.005	0.093	0.069	0.034	0.064
ln_Age	0.068	-0.005	-0.062	0.047	-0.018	0.124**	-0.082	0.053
Gender	-0.031	-0.092	0.106*	0.011	0.049	-0.083	0.096	0.09
Degree	0.067	-0.014	-0.055	0.017	-0.005	0.154***	-0.165***	0.039

	Growth1	Q1	Size1	ln_GDP1	ln_DepTotalSalary	ln_Capexp1	ln_Top3Salary1	ln_MV1
Growth1	1							
Q1	-0.117**	1						
Size1	0.04	-0.459***	1					
ln_GDP1	-0.014	0.066	0.124**	1				
ln_DepTotalSalary	-0.161***	-0.135**	0.525***	0.268***	1			
ln_Capexp1	-0.01	-0.429***	0.715***	-0.02	0.358***	1		
ln_Top3Salary1	-0.123**	-0.142**	0.553***	0.261***	0.798***	0.379***	1	
ln_MV1	0.011	-0.175***	0.938***	0.189***	0.556***	0.629***	0.580***	1
Nature1	-0.042	-0.088	0.150**	0	0.09	0.165***	0.056	0.122**
ShareRatio1	0.092	-0.078	-0.206***	0	-0.199***	-0.058	-0.195***	-0.268***
ln_Boardsize1	-0.031	-0.134**	0.283***	0.013	0.101*	0.169***	0.052	0.276***
Leverage2	-0.027	0.059	0.195***	-0.033	0.100*	0.129**	0.056	0.220***
ROA2	0.03	-0.115*	0.041	0.014	0.008	0.02	0.003	-0.001
EPS2	0.005	-0.123**	0.135**	0.044	0.152**	0.061	0.095	0.101*
Growth2	-0.009	-0.024	-0.023	0.036	0.07	0.028	0.068	-0.034
Q2	0.056	0.238***	-0.189***	0.006	-0.075	-0.205***	-0.119**	-0.098
Size2	-0.041	-0.165***	0.466***	0.046	0.317***	0.351***	0.292***	0.450***
ln_GDP2	0.018	-0.025	0.121**	0.265***	0.186***	0.04	0.178***	0.126**
ln_DestTotalSalary	-0.059	-0.085	0.418***	0.197***	0.575***	0.290***	0.486***	0.453***
ln_Capexp2	-0.027	-0.255***	0.336***	0.009	0.235***	0.325***	0.211***	0.276***
ln_Top3Salary2	-0.012	-0.125**	0.290***	0.157***	0.333***	0.189***	0.302***	0.291***
ln_MV2	-0.029	-0.074	0.441***	0.085	0.314***	0.307***	0.271***	0.468***
Nature2	-0.026	-0.013	-0.003	-0.131**	-0.056	0.06	-0.015	-0.01
ShareRatio2	0.028	-0.055	-0.132**	0.078	-0.119**	-0.164***	-0.101*	-0.164***
ln_Boardsize2	-0.082	0.056	0.059	-0.037	0.101*	0.055	0.027	0.071
ln_Age	-0.117**	-0.067	0.115*	0.063	0.297***	0.164***	0.166***	0.119**
Gender	-0.055	-0.005	0.056	-0.123**	0.121**	0.038	0.023	0.063
Degree	-0.038	-0.052	0.111*	0.157***	0.104*	0.049	0.074	0.109*

	Nature1	ShareRatio1	ln_Boardsize1	Levergae2	ROA2	EPS2	Growth2	Q2
Nature1	1							
ShareRatio1	-0.198***	1						
ln_Boardsize1	0.142**	-0.199***	1					
Leverage2	0.041	-0.174***	0.097	1				
ROA2	-0.015	0.064	0.077	-0.131**	1			

EPS2	0.016	-0.001	0.043	0.02	0.637***	1		
Growth2	0.106*	0.039	0.016	-0.105*	0.165***	0.137**	1	
Q2	-0.034	0.012	-0.04	0.003	0.023	-0.116*	-0.092	1
Size2	0.062	-0.191***	0.072	0.464***	-0.018	0.260***	0.067	-0.500***
ln_GDP2	0.014	-0.014	-0.068	0.015	-0.086	0.082	-0.086	-0.08
ln_DestTotalSalary	0.046	-0.175***	0.075	0.160***	0.089	0.286***	0.059	-0.212***
ln_Capexp2	0.042	-0.101*	0.083	0.195***	0.107*	0.265***	0.135**	-0.510***
ln_Top3Salary2	-0.03	-0.098*	0.03	0.140**	0.032	0.233***	0.017	-0.223***
ln_MV2	0.053	-0.199***	0.087	0.494***	0.006	0.263***	0.046	-0.210***
Nature2	0.09	-0.044	0.044	0.143**	-0.008	-0.026	-0.098	-0.097
ShareRatio2	0.013	0.173***	-0.072	-0.289***	0.041	0.031	0.071	-0.076
ln_Boardsize2	-0.008	-0.102*	0.125**	0.205***	-0.05	0.064	-0.07	-0.034
ln_Age	0.107*	-0.157***	0.109*	0.032	0.007	0.03	0.004	-0.048
Gender	0.022	-0.013	0.03	-0.005	-0.052	-0.013	-0.022	-0.145**
Degree	0.024	-0.039	0.007	0.019	-0.004	0.004	0.088	-0.052

	Size2	ln_GDP2	ln_DestTotal Salary	ln_Capexp2	ln_Top 3Salary 2	ln_MV2	Nature2	ShareRatio2
ln_asset2	1							
ln_GDP2	0.143**	1						
ln_DestTotalSalary	0.488***	0.183***	1					
ln_Capexp2	0.694***	0.072	0.287***	1				
ln_Top3Salary2	0.486***	0.209***	0.643***	0.331***	1			
ln_MV2	0.934***	0.127**	0.486***	0.606***	0.477***	1		
Nature2	0.131**	0.047	-0.019	0.078	-0.072	0.092	1	
ShareRatio2	-0.298***	0.099*	-0.142**	-0.128**	-0.145**	-0.372***	-0.179***	1
ln_Boardsize2	0.258***	0.065	0.110*	0.163***	0.174***	0.278***	0.054	-0.204***
ln_Age	0.117**	-0.033	0.202***	0.157***	0.082	0.097	0.120**	-0.207***
Gender	0.082	-0.083	-0.009	0.146**	-0.037	0.051	0.047	-0.023
Degree	0.126**	0.059	0.096	0.067	0.026	0.093	0.021	-0.026

	ln_Boardsize2	ln_Age	Gender	Degree
ln_Boardsize2	1			
ln_Age	0.147**	1		
Gender	0.041	0.213***	1	
Degree	-0.012	0.202***	0.031	1

Notes
*, ** and *** indicate the significance at the 10%, 5%, and 1% levels, respectively. Those variables ending in "1" representing origination (before turnover) variables and those ending in "2" representing destination (after turnover) variables.

regions air quality may struggle to retain and attract talented individuals, leading to a loss of human capital and potential economic growth. This underscores the importance of addressing environmental issues not only for public health but also for sustainable development in the long term. However, it is important to note that the relationship between executive mobility and air quality is not static. As environmental awareness increases and policies evolve over time, executives may more strongly prioritize locations with better air quality. This suggests that ongoing research in this field is necessary to understand the impact of evolving environmental attitudes on long-term executive decision-making processes.

5.3 The Impacts of Executive Mobility on Compensation

The results in Section 5.2 support H1; I conclude that departing executives who worked in a polluted area are more likely to relocate to a city with better air quality. In this section, I investigate whether executives' choice of working location causes salary difference. To test H2, the key explanatory variable is ΔAQI, which I measure by three dummy variables: $\Delta AQI > 0$, $\Delta AQI = 0$, and $\Delta AQI < 0$. The dependent variable, Salary Difference, is defined as a departing executive's total salary after turnover minus total salary before turnover in a year. The estimated results are presented in Table 4. In columns (1) – (4), there is an insignificantly negative relationship between executives' mobility and salary difference. Especially in columns (1) and (2), the coefficient for $\Delta AQI > 0$ is negative but not statistically significant. This indicates that moving to a region with better air quality does not have a significant impact on the change in executive compensation because of those executives have more concern on air pollution. Column (5) of Table 4 shows that the regression coefficient of $\Delta AQI < 0$ is 0.17, indicating that executives who move to cities with poorer air quality receive higher compensation. However, the significantly positive coefficient is mitigated when I add control variables to the model in column (6).

Consistent with Zhu et al. (2021), higher executive compensation does not mitigate the effects on executive turnover; thus, a consequence of relocation not related to their compensation. Therefore, air quality is not the primary factor in deciding executives' compensation. The finding indicates that factors other than air quality may be more influential in determining compensation changes before and after turnover. For example, the size of the original and destination firm may have more impacts on executive compensation, which is consistent with Gabaix and Landier (2008). Also, the study of Zhu et al., (2021) provided evidence on the role of compensation as executive tenure extends. They suggest that higher executive compensation helps mitigate the effects of executive turnover as their tenure extends.

Table 3

The impact of regional air quality on executive mobility.

	ΔAQI > 0	ΔAQI > 0	ΔAQI > 0	ΔAQI > 0
	(1)	(2)	(3)	(4)
ln_AQI1	0.723***	0.708***	0.649***	0.729**
	(9.26)	(8.12)	(8.08)	(2.13)
Size1		-0.023	-0.018	-0.053
		(-0.96)	(-0.46)	(-1.15)
Leverage1		0.150	0.144	0.123
		(1.24)	(1.21)	(0.88)
ROA1		-0.124	-0.048	0.131
		(-0.34)	(-0.13)	-0.32
ln_Capexp1		0.005	0.002	0.009
		(0.60)	(0.30)	(0.50)
Growth1		-0.038	-0.035	-0.01
		(-1.08)	(-0.98)	(-0.18)
ln_Top3Salary1		-0.021	-0.026	-0.028
		(-0.50)	(-0.62)	(-0.62)
ShareRatio1		0.001	0.001	0.002
		(0.72)	(0.77)	(0.9)
ln_Boardsize1		-0.126	-0.092	-0.026
		(-1.18)	(-0.71)	(-0.17)
ln_Age		0.106	0.143	0.133
		(0.63)	(0.72)	(0.57)
Degree		0.012	0.015	0.036
		(0.42)	(0.53)	(1.07)
Gender		-0.115*	-0.138**	-0.054
		(-1.81)	(-0.69)	(-0.64)
ln_GDP1		0.004	0.002	0.263
		(0.13)	(0.10)	(0.41)
Size2			0.01	0.008
			(0.49)	(0.33)
ln_GDP2			-0.083***	-0.102***
			(-3.79)	(-3.98)
ROA2			-0.189	-0.064
			(-0.86)	(-0.26)
Constant	-2.563***	-2.122***	-1.934**	-2.821*

	(-4.57)	(-1.59)	(-1.57)	(-1.78)
Observations	467	401	401	401
Industry	YES	YES	YES	YES
Year	YES	YES	YES	YES
City	NO	NO	NO	YES
Adj. R-squared	0.154	0.142	0.170	0.177

Notes

This table presents the regression estimations of the impact of regional air quality on executive mobility. ΔAQI > 0 is a dummy that equals 1 if an executive relocates to a city with better air quality than the original city, and zero otherwise. ln_AQI1 is log of AQI for the city where the executive was located before turnover. Those variables ending in "1" represent origination (before turnover) variables and those ending in "2" represent destination (after turnover) variables. Detailed definitions of all the variables are provided in the Appendix. In column (1), I only include AQI as the independent variable. From column (2), I add other original firm and city characteristics that may affect executive mobility. In column (3), I include destination firm and city characteristics. In column (4), I control for city fixed effects. Industry and year fixed effects are included in columns (1) to (4). z-Statistics are calculated based on robust standard errors clustered are reported in parentheses below the coefficient estimates. Statistical significance at the 1%, 5%, and 10%levels is denoted by ***, **, and *, respectively.

They conclude that managers who work for larger companies would receive higher salaries because of more growth potential. Comparing the results of ΔAQI < 0 with ΔAQI > 0 and ΔAQI = 0, this result also reveals that executives who relocated to the polluted area become more sensitive to compensation than those who migrate to cities with better air quality or stay in the same area. Thus, compared with regional air quality, post-turnover firm size is a stronger predictor of increased executives' compensation.

Except for monetary compensation, future studies could investigate the extent to which non-monetary compensation. From the perspective of local agencies and government, attracting and retaining executives in more polluted regions can be achieved through various measures at improving their living conditions. For instance, providing better housing allowances would enable executives to afford cleaner and healthier environments. Additionally, enhancing healthcare benefits could ensure executives access quality medical services to mitigate the potential health risks associated with air pollution. However, it is worth noting that there are a limited number of studies analyzing the specific relationship between air pollution and medical costs, particularly in China (An & Heshmati, 2019; Zeng & He, 2019). Further research in this area would provide valuable insights into the financial implications of air pollution on individuals' health expenses. From the perspective of corporate, flexible work arrangements, professional development opportunities, or work-life balance initiatives also hold implications for executive mobility choices.

In addition, future research could explore the long-term implications of remote work trends that have been accelerated by the Covid-19 pandemic. The shift towards remote work has not only transformed the way we work but also impacted executives' mobility decisions and compensation expectations. With the rise of remote work, executives now have more flexibility in choosing where they live and work and expand the talent pool for firms that allow them to recruit from a wider geographical area. Employers might need to adapt their strategies in order to attract top executive talent who value the option of working from locations with better air quality. Offering flexible arrangements or additional benefits related to environmental factors could become essential components of competitive compensation packages. However, due to travel restrictions and health concerns, regional firms become harder to attract and retain senior talents from abroad, and executives also have fewer opportunities for international assignments.

6. Additional tests

In the following sections, for brevity, I focus only on the results where all the control variables are included in the model specification and show only the key coefficients and t-statistics associated with the air quality.

6.1 The Role of Company Performance

In this section, to assuage the concern that firm performance has a greater impact on executive mobility than air pollution. Prior literature has found that air pollution reduces worker productivity and overall firm performance because of higher physical and mental health risks (Chang et al., 2014; Chang et al., 2016; Chang et al., 2019; Zivin & Neidell, 2012). To measure firm performance in my analysis, I follow the approach used by Zhu et al. (2021) and Graham et al. (2020), using two commonly used indicators: Return on Assets (ROA) and Tobin's Q. Tobin's Q (Q) is defined as the market value of total equity over the book value of total equity. Then, analyzing the impact of firm performance on executives' mobility by introducing the interaction term, ln_AQI1*ROA and ln_AQI1*Q into Model (1). The dependent variable is ΔAQI >0, which is equal to 1 if departing executives migrate to the city with better air quality, and 0 otherwise. These models allow me to examine whether executives who located in polluted area are still likely to move to regions with better air quality if they have good firm performance. The logistic regression models (3) and (4) are formulated as follows:

$$\boldsymbol{\Delta AQI > 0_{t+1} = a_0 + a_1 lnAQI1_t * ROA + \sum a_n Controls_{i,t} + \varepsilon_{i,t}} \quad \textbf{(3)}$$

Table 4

The impacts of executive mobility on their compensation.

	Salary Difference = Total salary after turnover - Total salary before turnover					
	(1)	(2)	(3)	(4)	(5)	(6)
ΔAQI > 0	-0.054	-0.004				
	(-0.65)	(-0.05)				
ΔAQI = 0			-0.156	-0.144		
			(-1.58)	(-1.41)		
ΔAQI < 0					0.170**	0.120
					-2.03	-1.31
ln_AQI1		-0.025		-0.031		0.041
		(-0.14)		(-0.19)		-0.24
Size1		-0.109**		-0.104*		-0.107*
		(-1.98)		(-1.90)		(-1.95)
Leverage1		0.185		0.162		0.170
		(0.84)		(0.74)		(0.77)
ROA1		-0.394		-0.505		-0.466
		(-0.58)		(-0.75)		(-0.69)
ln_Capexp1		-0.013		-0.014		-0.012
		(-0.37)		(-0.40)		(-0.35)
Growth1		0.112*		0.104		0.105
		(1.72)		(1.6)		(1.62)
ShareRatio1		0.002		0.002		0.002
		(0.72)		(0.64)		(0.71)
ln_Boardsize1		-0.068		-0.046		-0.053
		(-0.35)		(-0.24)		(-0.27)
ln_Age		-0.322		-0.328		-0.304
		(-1.08)		(-1.11)		(-1.03)
Degree		0.026		0.018		0.024
		(0.56)		(0.39)		(0.53)
Gender		-0.277**		-0.286***		-0.289***
		(-2.59)		(-2.67)		(-2.70)
ln_GDP1		-0.042		-0.036		-0.036
		(-0.97)		(-0.83)		(-0.82)
Size2		0.122***		0.122***		0.121***
		(3.93)		(3.92)		(3.89)
ln_GDP2		0.037		0.043		0.036
		(0.92)		(1.06)		(0.90)
Constant	0.905	1.943	0.855	1.833	0.784	1.450
	(1.13)	(1.07)	(1.08)	(1.02)	(0.99)	(0.79)

Observations	381	337	381	337	381	337
Industry	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES
Adj. R-squared	-0.0372	0.0750	-0.0304	0.0821	-0.0252	0.0812

Notes

This table presents the regression estimations of the impacts of executive mobility on their compensation. ΔAQI > 0 is a dummy that equals one if an executive relocated to the city with better air quality than the original city, and zero otherwise. Salary Difference represents the difference of the executive's total compensation in a year before and after turnover, which is equal to total salary after turnover minus total salary before turnover in a year. Those variables ending in "1" representing origination (before turnover) variables and those ending in "2" representing destination (after turnover) variables. Detailed definitions of all the variables are provided in the Appendix. In columns (1), (3), and (5), I only include ΔAQI > 0, ΔAQI = 0, and ΔAQI < 0 as the independent variable, respectively. In columns (2), (4), and (6), I include other control variables. Industry and year fixed effects are included in columns (1) to (6). z-Statistics calculated based on robust standard errors are reported in parentheses below the coefficient estimates. Statistical significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

$$\Delta \boldsymbol{AQI} > \mathbf{0}_{t+1} = \boldsymbol{a_0} + \boldsymbol{a_1 lnAQI1_t} * \boldsymbol{Q} + \sum \boldsymbol{a_n Controls_{i,t}} + \boldsymbol{\varepsilon_{i,t}} \quad \textbf{(4)}$$

In columns (1) and (2) of Table 5, the coefficients on ln_AQI1 are 0.625 and 0.637, which are positive and significant at the 1% level, p-values are 5.45 and 5.57, respectively. The result is consistent with Table (1), which indicates that executives are more likely to relocate to cities with better air quality. Then, I add the interaction items ln_AQI1*ROA and ln_AQI1*Q to columns (1) and (2), respectively. To test that to what extent the impacts of firm performance on executives' mobility. Both models control for origination, destination characteristics, and executive characteristics, along with industry and year fixed effects, to account for a comprehensive range of factors that could influence executive mobility. The adjusted R-squared values indicate that the models explain a reasonable proportion of the variance in executive mobility decisions related to air quality.

However, the coefficients of ln_AQI1*ROA and ln_AQI1*Q are statistically insignificant and negative, suggesting that although executives do consider air quality as an important factor in relocation decisions, it does not significantly influence their choices based on the original firm's performance measured by ROA or Tobin's Q indicators. The result further supports the evidence from Zhu et al. (2021). The findings suggest that departing executives are more likely to relocate to cities with better air quality, and their former firms' initial performance does not influence their choice of work location or career mobility. Consequently, poor regional air quality may negatively impact firm performance, resulting in increased turnover in the short term but has weaker effects on executive career paths in the long term.

Table 5
The role of company performance in the relationship between air quality and executive mobility.

	ΔAQI > 0	ΔAQI > 0
	(1)	(2)
ln_AQI1	0.625***	0.637***
	(5.45)	(5.57)
ln_AQI1*ROA	-0.019	
	(-0.22)	
ln_AQI1*Q		-0.004
		(-1.40)
Origination characteristics	YES	YES
Destination characteristics	YES	YES
Executive characteristics	YES	YES
Constant	-1.849	-1.484
	(-1.45)	(-1.15)
Observations	370	370
Industry	YES	YES
Year	YES	YES
Adj. R-squared	0.126	0.132

Notes
This table presents the results of investigating the impacts of firm performance on executives' mobility. The aim is to assess the importance of the firm performance while executive chose their work location. Detailed definitions of all the variables are provided in the Appendix. In column (1), I use ln_AQI1*ROA as the second independent variable. In column (2), I use ln_AQI1*Q as the second independent variable. All origination, destination firm, and executive characteristics are controlled. I include industry and year fixed effects in both regressions and p-values from robust standard errors are reported in parentheses. Statistical significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

6.2 Alternative Ways of Measuring Air Quality

In order to further examine the relationship between air quality and executive mobility decisions, additional robustness checks were conducted using alternative measures of regional air quality. Using four dummy variables that are equal to I if the original Air Quality Index is between 0 and 50 (AQI1 0-50), between 50 and 100 (AQI1 50-100), between 100 and 150 (AQI1 100-150), and between 150 and 200 (AQI1 150-200), and 0 otherwise.[24] Table 6 presents an analysis of executive mobility decisions in relation to varying levels of air quality at the original location. The purpose of this test is to explore how varying levels of air quality at the origin location might impact executive decision-making.

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[24] Following the study of Hao et al. (2023), they use excellent air quality (AQI ≤ 50) and terrible air quality (AQI above 100) to construct alternative measures of air quality.

Table 6

Panel A: Summary statistics

	AQI 0-50	AQI 50-100	AQI 100-150	AQI 150-200
N	18	352	94	2

Panel B: Alternative ways of measuring air quality.

	ΔAQI > 0	ΔAQI > 0	ΔAQI > 0	ΔAQI > 0
	(1)	(2)	(3)	(4)
AQI1 0-50	-0.247*			
	(-1.70)			
AQI1 50-100		-0.190***		
		(-2.79)		
AQI1 100-150			0.288***	
			(3.82)	
AQI1 150-200				0.201
				(0.51)
Origination characteristics	Yes	Yes	Yes	Yes
Destination characteristics	Yes	Yes	Yes	Yes
Executive characteristics	Yes	Yes	Yes	Yes
Constant	1.393	1.43	1.27	1.322
	(1.19)	(1.23)	(1.10)	(1.12)
Observations	401	401	401	401
Industry	YES	YES	YES	YES
Year	YES	YES	YES	YES
Adj. R-squared	0.0320	0.0476	0.0686	0.0233

Notes

This table presents the four alternative measures of air quality, which are dummy variables that are equal to I if the original Air Quality Index is between 0 and 50 (AQI1 0-50), between 50 and 100 (AQI1 50-100), between 100 and 150 (AQI1 100-150), and between 150 and 200 (AQI1 150-200). In column (1) to (4), I use AQI1 0-50, AQI1 50-100, AQI1 100-150, and AQI1 150-200 as independent variable, respectively. All models control for origination characteristics, destination characteristics, and executive characteristics, alongside industry and year fixed effects, to ensure that the results are not confounded by these factors. Detailed definitions of all the variables are provided in the Appendix. I include industry and year fixed effects in all regressions and p-values from robust standard errors are reported in parentheses. Statistical significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

Table 6 provides a comprehensive analysis of executive mobility decisions in relation to various levels of air quality. As reported in column (1)-(2) of Table 6, the coefficients are significantly negative, indicating that executives are less likely to relocate from areas with good air quality due to desirable environmental conditions. In column (3), the coefficient on AQI1 100-150 is 0.288, which is positive and statistically significant at the 1% level. This result aligns with previous findings reported in Table (3). This finding suggests that executives tend to seek out the workplace with better air quality once air quality deteriorates to this level (AQI above 100). It is widely acknowledged that AQI values exceeding 100 indicate unhealthy air conditions, according to the study of Li et al. (2021). In addition, these results further demonstrate that executives from areas with either very high or very high air quality are less likely to relocate for better air quality, while those from areas with moderately poor air quality show a higher propensity to move.

However, it is worth noting that in column (4), the coefficient for the AQI1 150-200 is positive but not statistically significant, indicating that there is not enough evidence to conclude that executives from areas with poor air quality are more likely to move for better air quality. Possible explanations for this include limitations arising from a smaller sample size within this specific range. Another concern is that the decision to relocate might be influenced by other unobserved factors at more severe pollution levels, which may include job opportunities available in their current location, compensation adjustments associated with relocation, or personal thresholds for tolerable air quality.

Overall, these robustness checks provide additional insights into how different levels of regional air quality may influence executive decision-making regarding relocation. The adjusted R-squared values vary across models, with the higher explanatory power observed in columns (2) and (3), suggesting that the AQI range of 50-150 is most predictive of executive mobility decisions in relation to air quality. Because of the relatively larger sample size than the other two ranges. However, we need further analysis to conclude that executives residing in moderately poor air quality areas are more likely to consider relocating for better air quality by increasing the sample size for the other two ranges.

6.3 Regression Discontinuity (RD) Methodology

In this section, I use a regression discontinuity design (RDD) that exploits discontinuous variation in air pollution created by China's heating system at the Qinling-Huai River (QH) boundary (Almond et al., 2009).[25] The Huai River policy had significant implications for air

[25] Based on the difference in winter heating in China's north and south, Chen et al. (2013) studied the impact of air pollution from fossil fuel consumption on life expectancy in the north and south, and they find that the average concentration of total suspended particulate matter (SPM) in the air can reach 184 μg/cubic meters in northern China, which is 55% higher than in the south; life expectancy in the north is 5.5 years shorter than in the south.

Table 7
Summary of Regression Discontinuity (RD) methodology based on the Huai River policy.

	North					South				
	N	mean	sd	min	max	N	mean	sd	min	max
ln_AQI1	153	4.567	0.253	3.860	5.447	314	4.272	0.217	3.745	4.811
ln_AQI2	153	4.452	0.272	3.777	4.995	314	4.332	0.248	3.686	4.898
ΔAQI > 0	153	0.542	0.499	0	1	314	0.334	0.473	0	1
ΔAQI = 0	153	0.203	0.403	0	1	314	0.184	0.389	0	1
ΔAQI < 0	153	0.255	0.437	0	1	314	0.480	0.500	0	1

Those variables ending in "1" representing origination (before turnover) variables and those ending in "2" representing destination (after turnover) variables.

Table 8
Regression Discontinuity (RD) methodology based on the Huai River policy to examine the effect of air pollution on executive career mobility and salary difference.

	ΔAQI > 0	Salary Difference
	(1)	(2)
North	0.184***	0.026
	(2.96)	(0.31)
Origination characteristics	Yes	Yes
Destination characteristics	Yes	Yes
Executive characteristics	Yes	Yes
Constant	0.768	4.333***
	(0.65)	(2.61)
Observations	381	334
Industry	YES	YES
Year	YES	YES
Adj. R-squared	0.0532	0.1770

Notes
This table presents an RDD to examine the effect of air pollution on executive career mobility. In Column (1), the dependent variable is ΔAQI > 0, to explore whether the Huai River policy affects executive mobility. In column (2), I use Salary Difference as the dependent variable, aiming to test whether the Huai River policy generate subsequent influence on executive salaries through workplace decision. Detailed definitions of all the variables are provided in the Appendix. All origination, destination firm, and executive characteristics are controlled. I include industry and year fixed effects in both regressions and p-values from robust standard errors are reported in parentheses. Statistical significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

pollution levels in China. In detail, northern Chinese cities received free unlimited heating between November 15 and March 15 due to budgetary constraints. The heating system relies on coal-based hot water boilers and is used on the north side of the QH boundary. As a result, the level of pollution is significantly higher on the north side of the QH boundary than on the south side due to the inefficient burning of coal in boilers.

In addition to the negative effects on air quality, research conducted by Chen et al. (2013) highlights another alarming consequence of China's heating policy - a decrease in life expectancy for millions of residents in northern China. The study estimates that over 2.5 billion life years are lost due to elevated levels of total suspended particulates (TSPs) caused by this policy. Also, the impact of the heating policy on air pollution in China is not limited to just the winter months. Studies have shown that the increased use of coal for heating purposes has led to a significant increase in particulate matter and other harmful pollutants throughout the year (Fan et al., 2020). This continuous exposure to high pollution levels has serious implications for public health.

Afterwards, Hao et al. (2023) found that China's central heating policy creates an abrupt change in AQI between cities located on either side of the Huai River. This discontinuity not only affects air quality but also has implications for executive mobility, compensation and promotion within companies operating in these regions. The disparity in AQI resulting from different winter heating practices further emphasizes the importance of addressing regional differences when formulating environmental policies.

Numerous evidence have shown that there is a significant disparity in air quality between north and south of China. For instance, one notable incident that exemplifies this contrast occurred in December 2013 when China experienced a severe episode of air pollution characterized by dense haze extending from Beijing to Shanghai, particularly the cities in the northern regions. The concentrations of PM2.5 in Beijing reached levels 35 times higher than the recommended limit set by the World Health Organization (Zhang et al., 2014). Such extreme levels of air pollution not only pose serious health risks but also have adverse effects on various aspects of society. Therefore, the deteriorating air quality has posed challenges for companies operating in northern China when it comes to attracting and retaining senior talents from outside the region or abroad. [26]

To further understand the long-term impact of environmental policies on executive mobility within China, it is essential to investigate how specific measures like the Huai River policy have influenced decision-making processes among senior talents. Table 7 provides an overview of the descriptive statistics based on the Huai River policy. There are a total of 314 firms located in the southern region of China, while only 153 firms are situated in the northern region.

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[26] "Airpocalypse' drives expats out of Beijing ", Financial Times, April 1, 2013. Available at https://www.ft.com/content/46d11e30-99e9-11e283ca-00144feabdc0. (Xue et al., 2021, p. 6)

Expectedly, we observe that the mean natural logarithm of the AQI (ln_AQI1) before executive turnover is higher in the north (4.567) compared to the south (4.272), indicating generally poorer air quality in the northern area. Post-turnover (ln_AQI2), there's a decrease from 4.567 to 4.452 in ln_AQI in the north, suggesting that executives may be inclined to move towards regions with better air quality, leading to some improvement in environmental conditions.

The empirical results shown in Table 8, column (1) and (2) represent the impacts of air quality on executive mobility and subsequent effects on executives' salary differences, respectively. In column (1), the coefficient on the north is 0.184, and the p-value is 2.96, which is positive and significant at the 1% level. This result aligns with our earlier observation from descriptive statistics, indicating that executives may be motivated to seek better environmental conditions when origination air quality is poor. However, there is no significant relationship between air pollution and executive salary difference, indicating that while executives move for better air quality, the Huai River policy generates no subsequent influence on executive salaries through workplace decisions. These findings are consistent with previous results shown in Tables (4) and (5), further confirming that both air pollution levels and executives' mobility exhibit discontinuous jumps across the QH boundary established by the Huai River policy.

5.4. The Different Impacts at SOEs and Non-SOEs

Executives at state-owned enterprises (SOEs) are quasi-officials with a certain political status. China's SOEs are often characterized by groups in which executives can be promoted to another SOE with a higher political rank, thus gaining higher political status. According to the Civil Servant Law in China, executives at SOEs can be transferred to leading positions at government agencies. In addition, executives at SOEs have limited opportunities to go to privately owned or foreign enterprises (Chen et al., 2017). Therefore, compared with executives at non-SOEs, executives at SOEs are less willing to leave voluntarily because of the greater constraints they experience. Following Zhu et al. (2021), the negative impact of regional air quality on executive turnover is more pronounced at non-state-owned listed companies. In this study, I extend the impacts on executive mobility. In other words, this study not only focuses on executive turnover but also investigates whether different types of ownership affect executives' career paths after turnover and highlights the consequence of executives making workplace decisions after turnover.

Table 9

The different impacts at SOEs and non-SOEs.

	ΔAQI > 0	ΔAQI > 0	ΔAQI > 0
	SOEs	Non-SOEs	Total
	(1)	(2)	(3)
ln_AQI1	0.636	0.609***	0.660***
	(1.36)	(6.06)	(6.81)
AQI*nonsoe			-0.014
			(-0.93)
Origination characteristics	Yes	Yes	Yes
Destination characteristics	Yes	Yes	Yes
Executive characteristics	Yes	Yes	Yes
Constant	-0.661	-1.479	-1.657*
	(-0.12)	(-1.54)	(-1.88)
Observations	44	344	401
Year	YES	YES	YES
Adj. R-squared	-0.0676	0.1900	0.1700

Notes

This table presents the results of whether the impacts of regional air quality on executive mobility is differ between SOEs and non-SOEs. In column (1) and (2), I conduct regression analysis on subsample of SOEs and non-SOEs, respectively. In column (3), I add the second independent variable, AQI*nonsoe. Detailed definitions of all the variables are provided in the Appendix. Control variables including origination characteristics, destination characteristics, and executive characteristics are included in all models to ensure a comprehensive analysis. I include year fixed effects in all regressions and p-values from robust standard errors are reported in parentheses. Statistical significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

Of the empirical results presented in Table 9. In column (1), the regression coefficient is insignificant for the SOE subsamples. In columns (2) and (3), the coefficients are 0.609 and 0.66, which in the non-SOE samples and full sample are both positive significantly at the 1% level, and p values are 6.06 and 6.81, respectively. Consistent with prior studies, the results provide further evidence that executives at non-state-owned listed companies are more flexible and more likely to exercise choice regarding their workplace then those at state-owned listed companies. Consequently, these results highlight the significant influence of ownership type on executive mobility and subsequent decisions related to their working location.

Following Zhu et al. (2021), the adverse relationship between regional air quality and executive turnover is more pronounced at non-state-owned listed companies. To expand upon this evidence, I introduce an interaction term, AQI*nonsoe, as a second independent variable in column (3). This aims to investigate whether the impacts of type of ownership on executive mobility in terms of their choice of working location and career trajectory is more pronounced at non-state-owned listed companies than state-owned enterprises. However, the coefficient on AQI*nonsoe is -0.014 and has a statistically insignificant negative relationship with executive mobility. This finding suggests that ownership types have limited influence on executives' workplace choices following turnover, as regional air quality assumes a more crucial role in their decision-making process in choosing their workplace.

6. Conclusions

Air quality is an important factor in human health and life. Prior studies have investigated the relationship between regional air quality and executive turnover (Hao et al., 2023; Xue et al., 2021; Zhu et al., 2021). In this thesis, I utilize a unique dataset that tracks executives' information before and after turnover and merge it with the regional air quality index. The purpose is to examine how regional air quality influences executives' decisions regarding their work locations or career paths in China after turnover in the long term. Building upon the findings of Zhu et al. (2021), this thesis concludes that executives who are located in polluted areas are more inclined to relocate to cities with better air quality after turnover. This suggests that executives prioritize addressing air pollution concerns and seek opportunities to enhance their health and quality of life.

Furthermore, several robustness checks provide further support to reinforce the notion that air quality significantly influences executive mobility regarding their work location choice, with salary differences or firm performance exerting less impact on executive mobility. The outcomes of this study underscore the importance of considering the desired location of a firm's headquarters, not only to mitigate brain drain effects but also enhancing regional human capital stability when determining an optimal location for a firm's headquarters. In sum, this study helps regional policymakers and businesses inform decision-making processes related to location choices, talent retention strategies, and environmental regulations to promote healthier environments while also considering the needs and preferences of executives who play crucial roles in driving economic growth and development.

Ethical approval

This thesis does not contain any studies with human participants or animals performed by any of the authors.

Informed consent

Not applicable

Declaration of Competing Interest

The author declare that she have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this thesis.

Appendix

Definition of the variables.

Variable name	Variable definition
ΔAQI	The difference of Air Quality Index (AQI) between the cities executives' firm is located before and after turnover, which is equal to origination AQI minus destination AQI. ΔAQI>0 means the executive relocated to an area with less air pollution areas; ΔAQI<0 means the executive relocated to an area with more serve pollution area; ΔAQI=0 means the execuitve stayed in the same area.
ln_AQI1	The natural logarithm of AQI for the city where the executive was located before turnover.
ln_AQI2	The natural logarithm of AQI for the city where the executive was located after turnover.
Leverage	Total liabilities divided by total assets.
ROA	Net income divided by total assets.
Growth	The growth rate of the total assets of the company in the current year.
Q	Market value divided by total assets.
Size	The natural logarithm of the total assets of the company in a year.
ln_GDP	Regional economic development, which is the natural logarithm of GDP of the province where a listed company operates in the current year.
ln_TotalSalary	The natural logarithm of execuirve total executive compensation in a year.
ln_Capexp	the natural logarithm of the capital expenditures.
ln_Top3Salary	The natural logarithm of the Total salary of the three top-earning managers in a year.
ln_MV	The natural logarithm of the market value.
SOE	The type of ownership of a company: state-owned enterprises (which take a value of 0) and non-state-owned enterprises (which take a value of 1)
North	A dummy variable that equals to 1 if the original firm is located north of the Huai River line and 0 otherwise.
ShareRatio	The shareholding ratio of a company's executive.
ln_Boardsize	The natural logarithm of the total number of directors of the company in a year.
Gender	The gender of the executive, equal to 1 if the executive is male.
Degree	1= secondary school and below, 2= junior college, 3= Undergraduate, 4= Master's degree, 5= Doctoral degree, 6= other (published in other forms, such as honorary doctorate, correspondence, etc.), 7=MBA/EMBA
ln_Age	The natural logarithm of the age of the executive.

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