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The Impact of Financial Geographical Structure on Corporate Pollution Emissions

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Abstract. This chapter takes a macro perspective on the financial geographical structure, starting from the perspective of financial agglomeration and financial center spillover. Based on the Chinese industrial enterprise database, Chinese pollution emission database, and the China City Statistical Yearbook, it explores the impact of financial geographical structure on corporate pollution reduction. The study finds that local financial agglomeration and financial center spillover can significantly reduce the intensity of corporate pollution emissions, which remains robust after a series of rigorous tests. Mechanism analysis indicates that local financial agglomeration and financial center spillover can promote corporate pollution reduction through the effect of technological innovation. The research conclusions of this chapter can provide new insights for deepening the structural reform of financial supply side.

Keywords: Financial Geographical Structure; Corporate Pollution Emissions; Structural Reform of Financial Supply Side.

1. Introduction

The Chinese economy has transitioned from a high-speed growth stage to a stage of high-quality development. In order to adapt to and lead the economy towards the new normal, during the 13th collective study of the Political Bureau of the CPC Central Committee, General Secretary Xi Jinping emphasized that the market structure and innovation capability of China's financial industry do not meet the requirements of high-quality development. It is necessary to deepen the structural reform of the supply side and continuously enhance the ability of the financial industry to serve the real economy. In the face of the impact of the COVID-19 pandemic since 2020, General Secretary Xi Jinping stressed the need to "focus on expanding domestic demand and deepening reforms, accelerating the improvement of the domestic demand system." As the lifeblood of the modern economy, finance needs to continuously enhance the rational allocation of financial resources to serve the real economy. For a long time, China's financial resources have faced uneven spatial distribution, with the financial resources in municipalities directly under the central government and provincial capital cities being overly concentrated, while smaller cities and some remote areas have experienced inadequate financial resource supply (Zheng et al., 2016). This imbalance in financial resources may affect the credit supply capabilities in various regions, further impacting the accessibility of external funds for enterprises, and subsequently influencing the environmental pollution control of enterprises. Existing studies have mainly focused on the industry organization structure of financial supply (banking, insurance, securities structure), with minimal attention given to the spatial structure of financial resource supply and its effects on the micro-environmental impacts of enterprises.

The formation of a financial center occurs as financial institutions agglomerate within a certain spatial range, thereby establishing a financial system which further aggregates spatially. In the construction of financial centers, China's approach differs significantly from that of other developed countries. The establishment of over 30 financial centers in China has been orchestrated by the state (Sun and Fan, 2013). Once financial agglomeration reaches a certain level, can it exert spillover effects and thus influence non-central cities? Specifically, can the construction of financial centers have an impact on the pollution emissions of enterprises in non-central cities? Given these considerations,

this study investigates the impact of financial agglomeration and spillover from financial centers on enterprise pollution emissions. Furthermore, it delves into the mechanisms through which local financial agglomeration and financial centers affect enterprise pollution reduction, as well as the heterogeneous effects of financial agglomeration and financial center spillover on enterprises of different ownership and scales.

A closely related literature in the existing research focuses on the economic effects of financial geographical structure. Financial geographical structure refers to the spatial distribution and supply of financial resources (Cai et al., 2020). The uneven distribution and supply of financial geographical structure lead to certain differences in its impact on the economy. Domestic scholars generally divide the financial geographical structure into local finance and financial centers. The research of Zheng and Lu (2019), Tao et al. (2017), and Mao and Chen (2022) indicates that the development of local finance and financial centers can promote the upgrading of urban industrial structure, increase enterprise productivity, and drive the export of Chinese manufacturing enterprises. In addition, some scholars have studied the spillover effects of financial agglomeration and financial centers from the perspective of financial geography. The spillover effects of financial agglomeration and financial centers can be divided into positive spillover effects and negative spillover effects. For example, Audretsch et al. (1996), and Li and Wang (2014) found, through the use of spatial econometric models, that financial agglomeration has spillover effects on industrial production efficiency and urban economic growth.

Environmental pollution control has always been a hot topic in academic research. Enterprises are the main emitters of pollutants, and existing studies have explored the influencing factors of pollution emissions from various perspectives. These studies mainly focus on environmental regulatory policies (Wan et al., 2021), industrial agglomeration (Su and Sheng, 2021), market segmentation (Lv and Zhang, 2021), exports (Forslid et al., 2018), and trade liberalization (Chen, 2020; Shao, 2021) on the impact of enterprise pollution emissions.

A review of the literature reveals that the existing studies mainly examine the economic effects of financial geographical structure, with few studies dividing financial geographical structure into financial agglomeration and financial centers to examine their environmental effects on micro-enterprises. However, since enterprises are the main emitters of pollutants, studying the impact of financial geographical structure on enterprise pollution emissions and its mechanisms is of significant importance for optimizing the spatial layout of financial resources, deepening supply-side structural reforms, and promoting green development. Therefore, based on the China Industrial Enterprise Database, Enterprise Pollution Emission Database, and China City Statistical Yearbook from 2003 to 2014, this study investigates the effect of financial geographical structure on micro-enterprise pollution reduction from a central-local perspective.

The marginal contributions of this paper are mainly in the following aspects: (1) In terms of research perspective, there are few literatures on the environmental effects of financial geographic structure. This paper discusses the impact of financial agglomeration and financial center spillover on corporate pollution emissions from the dual perspective of financial geographic structure, and broadens the research perspective of financial geographic structure. (2) This paper not only systematically examines the overall impact of financial geographic structure on pollution emission of enterprises, but also analyzes the heterogeneous impact of financial geographic structure on pollution emission of enterprises according to the characteristics of different enterprises, providing a new idea for comprehensive analysis of the impact of financial geographic structure on pollution emission of enterprises.

2. Theoretical Analysis and Research Hypothesis

Enterprises' participation in environmental governance requires sufficient financial support. Typically, internal financing of enterprises is limited, and external financing, mainly from financial institutions such as banks, is the primary way for enterprises to secure funding. In the process of

enterprise pollution control, seeking assistance from financial institutions is essential. However, in this process, there may be issues such as information asymmetry and adverse selection between banks and enterprises. Furthermore, when enterprises seek help from financial institutions, they also need to incur certain transaction costs and time costs. Therefore, the accessibility of credit resources for enterprises has a significant impact on pollution reduction. In financial transactions, geographical distance can lead to information asymmetry. Financial information is mainly divided into "hard" information and "soft" information (Petersen and Rajan, 2002) [16]. Hard information refers to information that can be disseminated through information disclosure and independent third-party audits, such as balance sheets and income statements, while soft information can only be obtained through long-term contact, and as the distance between the supplier and the demander of funds increases, the transmission of this kind of information can be severely distorted or ineffective (Porteous, 1999) .However, soft information can be partially hardened to a certain extent through scoring techniques, but the transmission of soft information still has a certain distance attribute. Compared to non-local enterprises, local financial institutions will experience adverse selection and moral hazard issues in the signing and negotiation of financial contracts. This can harm the interests of non-local financial institutions, and as geographical distance increases, the degree of information asymmetry between the supplier and the demander of funds intensifies. On the other hand, an increase in geographica.

Geographical distance is an important factor in the study of financial geography structure. In real life, risks and uncertainties are omnipresent, and the transaction costs and risk issues arising from geographical distance are crucial in determining the accessibility of external funding for enterprises.

2.1. The Local Effects of Financial Agglomeration

The local effects of financial agglomeration on the promotion of enterprise technological innovation can be summarized in the following two aspects: Firstly, the process of financial agglomeration attracts the accumulation of financial institutions and auxiliary financial transaction institutions such as law firms, asset valuation, and guarantee agencies (Davis, 1990). This can to a certain extent improve the resource allocation efficiency of financial institutions, and the concentration of financial institutions within a certain region intensifies competition among them, continuously driving financial institutions to innovate products and provide higher quality financial services. This helps alleviate financing constraints for enterprises, providing them with a favorable financing environment and promoting technological innovation. On the other hand, the agglomeration of financial resources intensifies communication among various financial institutions, reducing the cost of obtaining information. At the same time, financial agglomeration facilitates closer communication and collaboration as well as resource sharing among participants in financial transactions, reducing the information costs of individual financial institutions, thereby lowering the financing costs for enterprises and reducing the cost of innovation, effectively promoting technological innovation for enterprises.

2.2. The Spillover Effects of Financial Centers.

The continuous evolution of financial agglomeration ultimately leads to the formation of different levels of financial centers at the geographical level (Reed,1989). These financial centers aggregate major financial intermediaries, financial markets, and financial functions within their respective regional areas, thereby facilitating significant advantages in promoting interbank lending, information sharing, network sharing, and the formation of a professional talent pool among financial institutions. Consequently, financial centers can enhance the efficiency of cross-regional financial resource allocation and cross-regional payment efficiency (Kinderberger, 1969). This not only alleviates financing constraints for enterprises in the financial center cities but also benefits in alleviating financing constraints for enterprises in peripheral areas, thereby generating certain spillover effects on technological innovation for enterprises in other prefecture-level cities within the province. Agarwal & Hauswald (2010) point out two forms of financial spillover. The first form is service

spillover, which mainly refers to the spread of financial resources through service personnel and the extension of service networks to peripheral areas; the second form, information spillover, refers to the process of the spread and diffusion of financial resources from the central area to peripheral areas. Service spillover depends on transport costs, while information spillover depends on information costs. Furthermore, this kind of spillover from financial centers has certain geographical boundaries, whereby the spillover effect gradually diminishes with increasing geographical distance. The development of technologies such as artificial intelligence and 5G communication provides assurance for financial centers to more effectively provide remote financial services to enterprises in remote peripheral areas. Financial institutions within financial centers can establish branches in peripheral areas, enabling enterprises in the periphery to obtain local loans and improve credit efficiency. A key characteristic of financial centers is the ability to conduct concentrated transactions, which can reduce the financing costs for enterprises and thereby alleviate their financing constraints. The alleviation of financing constraints may prompt enterprises to increase investment in research and development, thereby improving productivity (Buera and Shin, 2008). Consequently, the emissions of pollutants from enterprises at the production end are reduced, thereby achieving corporate pollution reduction.

2.3. Technological Innovation and Corporate Pollution Reduction

Existing research has confirmed from various perspectives that technological innovation can reduce corporate pollution emissions. It impacts corporate pollution emissions through several pathways. Firstly, technological innovation can upgrade industrial structure (Zhu and Zhang, 2023), leading to the emergence of new production processes and driving the shift of energy from industries with low productivity to those with high productivity. Secondly, technological innovation can promote pollution reduction at the production end by enhancing energy utilization efficiency. Lastly, the advancement of technological innovation in businesses contributes to the improvement of energy consumption structure, increasing the use of clean energy and thereby enabling the reduction of corporate pollution emissions. Furthermore, technological innovation can facilitate sharing and cooperation among businesses, such as the promotion and utilization of environmental protection technologies among enterprises, thus elevating the overall environmental protection level within the industry. In summary, technological innovation plays a crucial role in corporate pollution reduction, enabling companies to lower pollutant emissions through industrial structure upgrading, optimization of energy structure, and knowledge cooperation and sharing. In the empirical analysis, this study primarily examines how local financial agglomeration and financial center spillover drive technological innovation in enterprises, thereby achieving corporate pollution reduction.

Based on the aforementioned theoretical analysis, this paper posits the following research hypotheses:

Hypothesis 1: Both local financial agglomeration and financial centers contribute to facilitating corporate pollution reduction.

Hypothesis 2: Local financial agglomeration and financial centers primarily promote corporate pollution reduction through technological innovation.

3. Research Design and Sample Selection

3.1. Sample Selection and Data Sources

The data in this paper is mainly derived from the following databases: firstly, at the enterprise level, the data is sourced from the China Industrial Enterprise Database published by the National Bureau of Statistics and the China Corporate Pollution Emissions Database published by the former Ministry of Environmental Protection. Secondly, at the regional level, the data is sourced from the district-level data in the China City Statistical Yearbook. Taking into consideration the specific administrative hierarchy and administrative geographic boundary features of China, this paper excludes samples from municipalities directly under the central government and all provincial capital cities, designating the provincial capital cities as regional financial centers. Following the approach of Brandt et al.

(2012), this paper matches the industrial enterprise database and corporate pollution emissions database based on the enterprise name or enterprise code, and conducts the following data processing on the industrial enterprise database: (1) removal of samples with missing sulfur dioxide emissions; (2) removal of samples with fewer than 8 employees; (3) removal of samples with total assets less than fixed assets and current assets; (4) removal of samples with total liabilities, total assets, and total fixed assets less than or equal to 0 and missing; (5) removal of samples established before 1949; (6) removal of samples with missing control variables; (7) due to poor data quality in 2010, removal of samples from 2010; (8) to eliminate the influence of extreme outliers on the regression results, truncation treatment is applied to all continuous variables at the 5th and 95th percentiles.

3.2. Model Setting

In order to examine the impact of local financial agglomeration and the financial center perspective on the geographical structure of finance on corporate pollution emissions, this paper establishes the following baseline regression model:

$$SO_2int_{kit} = \alpha_0 + \alpha_1 Localfin_{it} + \alpha_2 Fincentre_{ct} + \alpha Control_{kt} + \theta_i + \nu_t + \varepsilon_{kit} \quad (1)$$

(1) Intensity of industrial pollution emissions

The logarithm of the ratio of sulfur dioxide emissions to industrial output is used as the main indicator of pollutant emissions in this study. The reason for choosing sulfur dioxide as the primary pollutant emission indicator is primarily due to the following reasons:1) China has the highest sulfur dioxide emissions, and sulfur dioxide is also included as one of the main indicators of pollutant emissions in the two control zone policies. 2) Sulfur dioxide is highly hazardous, and governments of various countries attach great importance to the emissions of sulfur dioxide. In addition, this study also selects the emission of chemical oxygen demand and the emission of industrial wastewater as robustness checks.

(2) Local financial agglomeration

There is a plethora of literature on the measurement indicators of financial agglomeration, mainly including the single-index measurement method and the multi-index measurement method. The single-index measurement method mainly includes measures of financial activity's geographical density, location quotient, industry concentration index, spatial Gini coefficient, and E-G index, among others. The multi-index measurement method mainly considers some factors of the financial industry for measurement. However, considering the availability and intuitiveness of the data, this study selects the geographical density of financial activity to measure the financial agglomeration of cities, with the following formula for calculation:

$$Localfin_{it} = Fin_{it} / S_{it} \quad (2)$$

Where i and t represent the city and the year respectively; $Localfin_{it}$ represents the financial agglomeration of city i in year t, Fin_{it} represents the intensity of financial activity in city i in year t, and S_{it} represents the geographical area of city i in year t. Since the intensity of financial activity in a region largely depends on the loan balance of financial institutions, this study adopts the year-end loan balance of financial institutions in the urban area from the China Urban Statistics Yearbook to measure the geographical area of the city.

(3) Financial Center Spillover

Based on the specific administrative hierarchy and geographical boundary characteristics of China, this paper delineates the spillover boundary of the financial center as the province, and at the same time, designates the provincial capital city of each province as the regional financial center. Due to the fact that the spillover effect of the regional financial center has a certain geographical distance decay characteristic, that is, the spillover effect will weaken with the increase of the distance between the provincial capital city and other cities within the province. Therefore, when depicting the spillover

effect of the financial center, this paper introduces the geographical distance between the provincial capital city and other cities within the province into the formula for the financial center spillover. In addition, since its specific calculation formula is as follows:

$$Fincentre_{ct} = Fin_{ct} / (d_{ic} * S_{ct}) \quad (3)$$

The table below represents the variables "c", "i", and "t" as the provincial capital city, the prefecture-level cities within the provincial capital city, and the target year, respectively. "$Fincentre_{ct}$" denotes the spillover effect of the financial center in the provincial capital city "c" in year "t". "S_{ct}" represents the built-up area of the county-level city in the provincial capital city "c" in year "t". "d_{ic}" represents the spatial distance from other cities within the province to the provincial capital city. The term $1/d_{ic}$ characterizes the distance decay feature from other cities within the province to the provincial capital city. "Fin_{ct}" denotes the intensity of financial activities in the provincial capital city "c" in year "t", measured using the year-end loan balance of financial institutions in the provincial capital city "c" in year "t".

(4) Controlling variables

Drawing from existing literature, the main selected control variables are as follows: the debt-to-asset ratio (*Debtass*) is measured by the total liabilities divided by total assets; the proportion of fixed assets *(Fixass*) is measured by the total fixed assets divided by total assets; capital intensity (*lnKl*) is measured by the total fixed assets divided by the total number of employees at the end of the year; firm age (*Firmage*) is measured by the difference between the year of observation and the year of establishment of the company; and firm size (*Firmsize*) is measured by the natural logarithm of total assets.

4. Empirical Results and Analysis

4.1. Descriptive Statistics of Variables

Table 1. Descriptive Statistics of Variables

Variables	N	Mean	Std	Min	Median	Max
SO2int	315721	3.03	2.082	0.000	3.0110	7.9659
Localfin	295711	10.82	0.740	9.203	10.7511	12.8001
Fincentre	285473	18.23	1.399	14.974	18.2840	21.1881
Firmage	315721	11.56	10.635	0.000	8	53
ln*Kl*	315721	4.38	1.369	0.778	4.3498	8.2951
Debtass	315721	0.59	0.288	0.026	0.5987	1.4868
Fixass	315721	0.40	0.220	0.024	0.3729	0.9191
Firmsize	315721	0.04	0.099	-0.397	0.0281	0.3622

4.2. Baseline Regression Results

Table 2 presents the estimation results of the baseline regression model. The first column displays the regression results without controlling for other variables. It is evident that the regression coefficients of the core explanatory variable, *Localfin*, are significantly negative at the 5% level, and the coefficient of *Fincentre* is significantly negative at the 1% level. The second column presents the regression results after controlling for other variables, which are largely consistent with the results without controlling for other variables, indicating that local financial agglomeration and financial center spillovers both contribute to the promotion of corporate pollution reduction.

Table 2. The Geographical Structure of Finance and Corporate Pollution Reduction

	(1)	(2)	(3)
	SO2int	*SO2int*	*SO2int*
Localfin	-0.3956***	-0.0300***	-0.0268**
	(0.0064)	(0.0115)	(0.0114)
Fincentre	-0.1992***	-0.1015***	-0.0763***
	(0.0033)	(0.0129)	(0.0127)
Firmage			0.0017**
			(0.0008)
ln*Kl*			0.0568***
			(0.0070)
Debtass			0.1716***
			(0.0193)
Fixass			-0.2142***
			(0.0287)
Firmsize			-0.3048***
			(0.0095)
_con	10.8992***	5.1896***	7.7976***
	(0.0639)	(0.2504)	(0.252)
Firm FE	No	Yes	Yes
Year FE	No	Yes	Yes
Observations	283409	260665	260665
Adj.R^2	0.0538	0.7943	0.7974

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors clustered at the firm level are reported in parentheses. All regressions in the table also control for firm fixed effects and time fixed effects. The same applies to the table below.

4.3. Endogeneity Test

When measuring the concentration of finance and the spillover effects of financial centers, financial activity intensity is taken as the basis. The measurement of financial activity intensity uses the year-end loan balance of financial institutions, taking into account the close relationship between the loan balance of financial institutions and the production and operation of enterprises. Additionally, some unknown factors affecting enterprise pollution emissions may be related to the loan balance of financial institutions. Omitting these variables may cause endogeneity issues. Based on the above analysis, this paper uses the instrumental variable (IV) method to reduce the endogeneity issues of the estimation results, and employs two-stage least squares estimation. The lagged savings balance of urban and rural residents in the previous period is used as the instrumental variable for the year-end loan balance of financial institutions. The reason for choosing the lagged savings balance of urban and rural residents as the instrumental variable is mainly because the lagged savings balance of residents is influenced by the savings-consumption preferences of urban and rural residents, and does not have a direct relationship with the pollution reduction behavior of enterprises. Therefore, its correlation with omitted variables related to enterprise pollution reduction is very low and can be considered an appropriate instrumental variable.

Table 3. Instrumental Variable Method

	(1)	(2)	(3)
	Localfin	*Fincentre*	*SO_2int*
finlocal	0.1677***	-	
	(0.0097)		
fincenter	-	0.1627***	
	-	(0.006)	
Localfin	-		-0.3112***
	-		(0.0691)
Fincentre	-		-1.1210***
			(0.1399)
F value of the first stage	352.22	412.28	-
Control	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
observation	152357	152357	152357

4.4. Robustness Test

(1) Substituting the Core Explanatory Variable

In the analysis of the benchmark regression results, the core explanatory variable of this study is measured using financial geographical density. In order to strengthen the reliability of the regression results, this study further uses the year-end deposit balance of financial institutions to construct financial geographical density as an indicator of financial agglomeration and financial centers for calculation, and re-estimates the model. The estimated results, as shown in the first column of Table 4, indicate that the regression coefficients of the core explanatory variables finlocal and fincenter are significantly negative at the 1% level, suggesting that the benchmark regression results are robust. Column (2) of Table 4 measures the spillover of local financial agglomeration and financial centers using the location quotient of financial practitioners, and the results remain robust.

(2) Substituting the Dependent Variable

In the analysis of the benchmark regression results, this study uses sulfur dioxide emission intensity as an indicator of industrial pollution emission intensity. However, sulfur dioxide is only one type of pollutant emitted by enterprises. Therefore, this study further measures the intensity of industrial wastewater discharge to assess the pollution emission intensity of enterprises, and re-estimates formula (1). The estimated results, as shown in the third column of Table 4, demonstrate that the regression results remain robust.

(3) Excluding Other Competitive Policies

The implementation of certain policies during the sample period of this study may have had a certain impact on the pollution emissions of enterprises. In order to eliminate the interference of these policies on pollution emissions, the present study regressed formula (1) by excluding the samples of the emission trading pilot policy. The regression results, as shown in the fourth and fifth columns of Table 4, indicate that after the exclusion of the interference caused by the emission trading pilot policy, there were no significant changes in the sign and significance of the core explanatory variables, thus confirming the robustness of the benchmark regression results.

(4) Replacing Fixed Effects

In order to further strengthen the pollution reduction behavior of the financial geographical structure, and to control for the unobservable factors that change annually at the city level and the industry level, the benchmark regression model was re-estimated. The regression results, as shown in the fifth column of Table 4, indicate that the regression coefficients of the core explanatory variables (*Localfin*) and (*Fincentre*) are significantly negative at least at the 5% level, consistent with the benchmark regression results, demonstrating the robustness of the regression results.

Table 4. Robustness Test

	(1)	(2)	(3)	(4)	(5)
	SO2int	*SO2int*	*Gwater*	*SO2int*	*SO2int*
Localfin	-0.0728***		-0.0087*	-0.0313**	-0.0348**
	(0.0147)		(0.0046)	(0.0153)	(0.0137)
Fincentre	-0.1189***		-0.0223***	-0.0885***	-0.1396***
	(0.0145)		(0.0055)	(0.0150)	(0.0142)
fcagg		-0.0316***			
		(0.0121)			
fincen		-0.1166***			
		(0.0381)			
_cons	9.1250***	6.351***	2.2980***	8.1720***	7.1628***
	(0.3284)	(0.037)	(0.1107)	(0.3329)	(0.2855)
Control	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	260665	253269	283673	128865	283374
Adj.R^2	0.7975	0.7967	0.7619	0.8079	0.4376

5. Mechanism Analysis

The previous theoretical analysis confirmed that the financial geography structure mainly promotes corporate pollution reduction through promoting technological innovation. Therefore, this section conducts empirical tests on the previous theoretical analysis to prove that local financial agglomeration and financial center spillover can indeed promote corporate pollution reduction through technological innovation effects. This article uses the number of invention patent applications, practical patent applications, and total patent applications in the Chinese patent database to measure the level of technological innovation of enterprises. At the same time, due to the large number of zero values in the number of patent applications of enterprises, their distribution types do not conform to normal distribution, and using linear regression models may lead to biased estimates. Therefore, a panel fixed effect Poisson distribution model is selected for analysis, At the same time, due to the time required for enterprises to successfully apply for patents from R&D and innovation, the control variables in columns (1) - (3) of Table 5 all lag by one period. Examine the impact of financial geographic structure on enterprise technological innovation. Using financial geographic structure (financial agglomeration and financial center) to regress the total number of patents and invention patents of enterprises, the regression results are shown in columns (1) and (2) of Table 5. It can be seen that the regression coefficients of the core explanatory variables (*Localfin*) and (*Fincenter*) in column (1) are significantly positive at the 10% level, Both local financial agglomeration and financial center spillover have significantly promoted the level of technological innovation of enterprises. The regression results in column (2) of Table 5 show that the regression coefficient of

the core explanatory variable (*Fincenter*) is significantly positive at the 10% level, indicating that provincial financial centers have a promoting effect on the invention innovation of enterprises in other prefecture level cities within the province. Further using the R&D innovation investment of enterprises as the dependent variable, the regression results are shown in column (3) of Table 5. Local financial agglomeration has a significant promoting effect on local R&D innovation. Through the above tests, this section proves hypothesis 2 that financial geography structure can promote corporate pollution reduction through technological innovation effects.

Table 5. Mechanism analysis

	(1)	(2)	(3)
	Patent	*Invent*	*R&D*
Localfin	0.1550*	0.0500	0.0936***
	(0.0852)	(0.0862)	(0.0353)
Fincentre	0.3094*	0.4206*	-0.0242
	(0.1689)	(0.2044)	(0.0317)
_cons	-6.9432*	-9.3064**	-0.5722
	(3.7989)	(4.4743)	(0.7428)
Control	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	33499	23193	43194
Adj.R^2	0.7352	0.7101	0.6833

6. Heterogeneity Analysis

In the benchmark regression results, this paper discusses the average treatment effect of financial geographic structure on the pollution emission intensity of enterprises, but the influence of financial geographic structure on the pollution emission intensity of enterprises may be different depending on the form of ownership and size of enterprises. Below, this paper mainly analyzes it from the perspective of enterprise heterogeneity.

(1) Heterogeneity of enterprise ownership forms

In order to test whether the influence of financial geographic structure on the pollution emission intensity of enterprises will be different due to the ownership form of enterprises, this paper divides all samples into state-owned enterprises and non-state-owned enterprises according to the registration type and holding status of enterprises, and investigates the influence of financial geographic structure on the pollution emission intensity of enterprises with different ownership. The regression results are shown in columns (1) and (2) of Table 6. It can be seen that the regression coefficients of the core explanatory variables (*Localfin*) and (*Fincentre*) in the sample group of non-state-owned enterprises are significantly positive, while the regression coefficients in the sample group of state-owned enterprises are not significant. The results show that the financial geographic structure has a significant promoting effect on the pollution reduction of non-state-owned enterprises, while the effect on the pollution reduction of state-owned enterprises is not obvious. The main reason is that state-owned enterprises are usually closely connected with the government, and the local government will inevitably provide explicit and implicit financial support to state-owned enterprises, which makes state-owned enterprises face the problem of "soft budget constraints" (Lin et al., 2009). Soft budgetary constraints on soes by state-owned enterprises and local governments may lead to a lack of pre-investigation and post-supervision by financial institution managers of soes in financing. However, for non-state-owned enterprises, their own foundation is relatively weak and they are more prone to

financing constraints. When financial agglomeration and financial center spillovers occur, non-state-owned enterprises have a greater role in alleviating financing constraints, which can promote technological innovation and promote pollution reduction. (2) Heterogeneity analysis of enterprise size

In this paper, all samples are divided into two categories: large enterprises and small and medium-sized enterprises according to the median total assets of enterprises, and the influence of financial geographic structure on pollution emissions of enterprises of different sizes is investigated. The regression results are shown in columns (3) and (4) of Table 6. The regression coefficient of the core explanatory variable (*finloca*l) in the sample group of large enterprises is significantly negative at the level of 5%, while the regression coefficient in the sample group of small and medium-sized enterprises is not significant, indicating that local financial agglomeration significantly reduces the pollution emission intensity of large enterprises, but has no impact on the pollution emission of small and medium-sized enterprises. The reason may be that the hard information of large enterprises is relatively perfect, and local financial institutions are more inclined to provide financial support to state-owned enterprises, so as to promote the improvement of the technological innovation level of state-owned enterprises and promote the pollution reduction of enterprises.

Table 6. Analysis of Enterprise Heterogeneity

	(1)	(2)	(3)	(4)
	Soe	*NSoe*	*Large*	*Small*
Localfin	-0.0539	-0.0240**	-0.0387**	-0.0115
	(0.0433)	(0.0118)	(0.0154)	(0.0176)
Fincentre	-0.0683	-0.0839***	-0.0578***	-0.0724***
	(0.0426)	(0.0144)	(0.0175)	(0.0194)
_cons	6.0648***	7.8896***	7.0738***	7.3635***
	(0.6122)	(0.2762)	(0.3729)	(0.3934)
control	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	15795	243453	129313	121154
Adj.R^2	0.8503	0.7938	0.8125	0.7953

7. Conclusion and Policy Implications

In the report of the 20th National Congress of the Communist Party of China, it is proposed to reduce pollution and carbon reduction, and the importance of pollution reduction is clarified. In this context, the influence of financial geographic structure on enterprise pollution emission is studied, which provides a new perspective for the realization of green development. Based on the matching data of China Industrial Enterprise Database, China Enterprise Pollution Emission Database and China City Yearbook from 2003 to 2014, this paper examines the influence of financial geographic structure on enterprise pollution emission from the perspective of local financial agglomeration and financial center spillover. The research results of this paper show that: First, local financial agglomeration and financial center spillover can reduce the pollution emission of enterprises. Mechanism analysis shows that local financial agglomeration and financial center spillover promote enterprise pollution reduction by promoting enterprise technological innovation. Heterogeneity analysis results show that the influence of financial geographic structure on enterprise pollution emission depends on the characteristics of enterprises themselves. Local financial agglomeration and financial center spillover both reduce the pollution emission level of non-state-owned enterprises, but have no significant effect on local pollution emission of state-owned enterprises. From the perspective of firm size

heterogeneity, local financial agglomeration and financial center spillover both reduce local pollution emissions of large enterprises, but have no significant impact on small and medium-sized enterprises.

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