

The Impact of the Industrial and Financial Cooperation Pilot on Urban Energy Transition: A Difference-in-Differences Approach

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Abstract: One of the important measures to support green transformation of industry and improve the real economy of financial services is to carry out a pilot program Industrial and Financial Cooperation Policies. This study employs a multi-period difference-in-differences (DID) approach for evaluating the impact of a pilot policy on urban sulfur dioxide (SO₂) emission intensity, based on panel data from 112 Chinese cities over the period 2014–2022. Controlling for both city and year fixed effects, our findings reveal that the pilot policy significantly increases the SO₂ emission intensity of treated cities, indicating that the policy fails to achieve its intended emission reduction. Robustness checks, including winsorization to mitigate the influence of outliers and the exclusion of municipalities from the sample, consistently confirm that the previously estimated effect remains statistically significant. An expansion of the industrial sector is indicated by mechanism analysis, which reveals that the policy considerably increases share of the secondary sector in GDP. The main cause of the rise in emission intensity is this structural change. According to heterogeneity analysis, the policy effect is statistically minor in resource-based cities and mostly concentrated in non-resource-based cities. Additionally, because treated cities have a larger patent base, even while the strategy increases total green patent applications, the proportional growth rate is less than that of the control group. In resource-based cities, the impact of green innovation is likewise negligible. This study provides empirical evidence for improving green finance policies by showing how Industrial and Financial Cooperation Policies may produce short-term environmental rebound effects by promoting industrial expansion.

Keywords: Industrial and Financial Cooperation Policies; Sulfur Dioxide (SO₂) Emission Intensity; Multi-period Difference-in-Differences; Structure Effect; Resource-based Cities.

1. Introduction

Global warming and an increasing number of climate-related calamities are being caused by greenhouse gas emissions, especially carbon dioxide. Advancing the energy transition is very important for sustainable economic and social development, so it has become a common view around the world. Since the turn of the century, China's fast economic growth and higher energy demand have put a lot of pressure on resources and the environment; therefore, a basic change in how energy is produced and used is needed.

The energy transition in cities is closely tied to finance, and policies that bring industry and finance together are an important market-based tool for making the ecological environment better. In this situation, a pilot policy for combining industry and finance was started, so that finance could play a bigger role in guiding changes in industry and the energy transition. In August 2016, a notice about organizing applications for industry-finance cooperation pilot cities was jointly issued by four bodies—the Ministry of Industry and Information Technology, the Ministry of Finance, the People's Bank of China, and the former China Banking Regulatory Commission; through this, the first group of 37 pilot cities was designated. To make the policy work better, five departments launched a second round of applications in 2020; as a result, 51 pilot cities were chosen, and 18 of them were cities that kept going from the first group. The third list of pilot cities was announced on June 14, 2024; it was made up of 29 newly picked cities and 37 cities that held onto their pilot status.

In this research, a method called multi-period difference-in-differences is used for the empirical regression analysis, and the national industry-finance cooperation pilot is treated as a quasi-natural experiment. The impact of such policies on urban energy transition is figured out by looking at how energy intensity changed in pilot cities and non-pilot cities before and after the policy was put into practice. To see how the program affects energy efficiency through green technology innovation and industrial structure upgrading, mechanism testing is also carried out. Through this, what financial policy does to transition results can be made clear, the mechanisms behind it can be explained in a step-by-step way, and a solid theoretical base can be given for pushing forward the "dual carbon" goals by means of cooperation between finance and industry.

2. Literature Review

2.1. The Effect of Industrial-Financial Cooperation on Upgrading Industrial Structure

Since reform and opening up, China's industrial structure has gone through several important changes, and the three main industries now show a "three-two-one" pattern, with the tertiary industry holding the largest proportion (Yu, 2015)[1]. According to Fu (2010)[2], economic growth is correlated with the modernization of the industrial structure, which is dependent upon economic growth. China's industrial structure has been substantially upgraded and rationalized thanks to the Industrial and Financial Cooperation pilot strategy (Wang,

2019)[3]. Therefore, strengthening current economic successes and promoting deeper industry transformation and upgrading depend heavily on the expansion of Industrial and Financial Cooperation Policies.

2.2. Impact of Industrial and Financial Cooperation on Corporate Financing

In order to maintain business operations and spur technical innovation, financing is a company's economic lifeblood. Lin and Li (2001)[4] pointed out that most small and medium-sized businesses (SMEs) in China need a lot of workers, so it is not practical for them to get money through the capital market; because of this, China's high-quality growth has to rely on Industrial and Financial Cooperation Policies to make financial services work better for the real economy (Liu et al., 2024)[5]; also, Sun (2025)[6] found, by looking at data from A-share listed companies, that the pilot program of industrial and financial cooperation pushed up the share of long-term corporate borrowing by a big amount; as a result, the time mismatch between borrowing and investing was reduced, and corporate financing became more effective; in addition, by cutting the costs of getting credit a lot, these policies can strengthen businesses' ability to get long-term financing and reduce their habit of putting short-term loans into long-term investments (He et al., 2025)[7]; this effect can be seen as an important example of how to push high-quality economic growth and keep away from systemic financial risks.

2.3. The Green Support Effect of Industrial and Financial Cooperation

Looking from the company side, businesses have become an important part of sustainable development plans, both in China and around the world; the Chinese government has been working hard to find governance methods to lift the ESG performance of companies, as ESG—a more complete and reasonable governance idea—gets more popular. One of these efforts is the industrial and financial cooperation pilot strategy, and it greatly improves the ESG performance of businesses (Zhuo et al., 2026)[8]. The green development of industry (Huang, 2024)[9] and the green transformation of manufacturing (Jiang, 2025)[10] are both strongly catalyzed and enabled by Industrial and Financial Cooperation Policies.

Macroeconomically speaking, Wang and Shang (2024)[11] show that Industrial and Financial Cooperation Policies greatly lower urban CO₂ emission intensity and improve CO₂ emission efficiency.

2.4. The Impact of Industrial and Financial Cooperation on Enterprise Innovation

Innovation is a vital route to methodically improving the effectiveness of the country's economy and is a potent force for resource allocation and industrial structure optimization. According to Liu et al.'s (2022)[12] empirical analysis of the innovation performance of listed companies impacted by the Industrial and Financial Cooperation pilot, the policy creates significant incentives for enterprise innovation. Specifically, it significantly boosts enterprises' degree of green innovation (Yuan et al., 2025)[13], production of green innovation (Han and Dou, 2025)[14], and quality of green innovation (Yang, 2024)[15]. In the meantime, Wang et al. (2024)[16] discover that businesses in national Industrial and Financial Cooperation pilot cities have markedly increased their patent applications; nevertheless, this increase is mostly due to non-invention patent applications.

Previous research has looked at macro-level things like how industrial structure is adjusted and how cities are made greener, and also at micro-level effects such as green innovation, green transformation, and how well finance works. These studies are quite complete, but the angles they use can still be made wider; what is not written about much is the way the industrial and financial cooperation pilot changes the intensity of sulfur dioxide (SO₂) emissions in cities, and this intensity is an important sign of environmental performance. This paper takes a viewpoint that centers on structure and effect, so it can check if the pilot policy changes urban SO₂ emission intensity by changing the share of the secondary industry; by doing this, a gap in what is already studied is filled, and a foundation is laid for the theoretical analysis and hypothesis testing that come later.

3. Theoretical Analysis and Hypothesis Development

3.1. Theoretical Analysis

The way money is spread around is changed a lot by industrial and financial cooperation policies, and these policies act as a guiding financial force in the country's way of governing; cities are the key channel that links micro-level businesses and macro-level policies. Enhancing the financing effectiveness of local green businesses is the primary motivator for the urban energy transformation. Low-carbon energy use and improved energy efficiency are the main characteristics of the urban energy transition. Nevertheless, these transition consequences are not directly produced by the policy. In theory, it mostly uses the following channels to have an indirect impact:

First, by setting up a national platform for bringing industry and finance together, the exchange of information gets a push, the information gap between industry and finance becomes smaller, and the financing limits that green businesses face are lowered; all of these help make their financing work more effectively. Second, through coming up with financial tools like green bonds and green loans, the policy guides money straight into green fields; this gives firms the drive to work on green energy technologies and to make environmental and energy-saving changes to their equipment and processes. Third, with the help of support that is made to fit, businesses that use a lot of energy are changed faster, and low-carbon industries are grouped together; in this way, a cleaner upgrade of the local industrial structure is pushed forward.

3.2. Research Hypotheses

The pilot policy of industrial and financial cooperation makes cities set up information-sharing platforms and green financial tools, so the reach and ease of getting green credit in the pilot areas are widened a lot; through this, the borrowing problems faced by green projects and companies are cut down. Besides, the policy gives a push to the green transformation of the city's industrial structure and raises the degree of green innovation in firms; this indirectly speeds up the building and taking up of clean energy and makes the whole change of the urban energy mix easier. What is more, for resource-based cities where the secondary industry takes up a large part, the extra effect that the policy has on bettering the energy structure is very likely to stand out even more.

The following theories are put forth in this study in light of the aforementioned analysis:

H1: The pilot policy for Industrial and Financial

Cooperation greatly encourages pilot cities to change their energy mix.

Cities chosen as pilots can optimize their distribution of funds by directing them toward clean energy production and green businesses. This successfully lowers the total intensity of sulfur dioxide (SO₂) emissions in the city.

H2: One important way that Industrial and Financial Cooperation policies propel the city-level energy transition is through urban green innovation.

We use the World Intellectual Property Organization's (WIPO) city-level green patent list to identify green patents, following the methodology of Zhao and Meng (2022) [17]. We measure the green innovation level of the first and second batches of pilot cities by their green patent application counts.

H3: Resource-based cities are more affected by the Industrial and Financial Cooperation policy's energy transition effect.

The base of carbon emissions is directly determined by the industrial structure. Resource-based cities rely significantly on mineral resource extraction and processing, and resource-based companies are often energy-intensive and emit high levels of pollutants. Because high-carbon sectors are likely to receive more green financing and technical upgrading help, the policy's emission-reduction effect is larger in these cities.

4. Research Design

4.1. Model Specification

This paper uses a multi-period difference-in-differences model for the empirical analysis and views the implementation of China's national Industrial and Financial Cooperation pilot city program in its first two batches as a quasi-natural experiment. The following is the model specification:

$$\text{Energy Structure}_{it} = \beta_0 + \beta_1 \text{Treat}_i \times \text{Period}_{it} + \beta_2 \text{Control}_{it} + \text{City}_i + \text{Year}_t + \varepsilon_{it}$$

Where Energy Structure_{it} represents the energy structure performance of city_i in year_t; Treat_i × Period_{it} is an indicator equal to 1 if city_i is treated in year_t; Control_{it} is a set of control variables; City_i represents city fixed effects; Year_t represents year fixed effects; ε_{it} is the disturbance term.

4.2. Variable Selection

The set of variables to be collected for this study is as follows:

(1) Dependent variable: SO₂ emission intensity (*SO2_intensity*) – measured as Industrial sulfur dioxide emissions (in kilograms) divided by city GDP (in ten thousand yuan).

(2) Primary independent variable: *did* – which takes the value of 1 for cities that are pilot cities of the Industrial and

Financial Cooperation policy, and 0 for non-pilot cities.

(3) Control variables:

Government size (*gov_size*) – measured as the share of general public budget expenditure in GDP.

Financial development level (*fin_dev*) – calculated as the ratio of year-end total deposits and loans to GDP.

City economic development level (*ln_pgdp*) – proxied by the natural logarithm of per capita GDP.

Industrial structure upgrading (*ind_upgrade*) – defined as the ratio of tertiary sector value added to secondary sector value added.

Green patents (*ln_green_patent*) – due to substantial variation across cities and the presence of zero values, we take the natural logarithm after adding one to all observations.

4.3. Data Sources and Processing

The data used in this study are drawn primarily from statistical yearbooks at various levels, including the China Energy Statistical Yearbook and the China Environmental Statistical Yearbook, as well as the list of Industrial and Financial Cooperation pilot cities, government work reports, the China Economic Information Network Statistical Database, the China Emission Accounts and Datasets (CEADs), and the Ministry of Industry and Information Technology.

The fundamental criteria of the difference-in-differences method—comparing periods before and after the policy—cannot be satisfied since the third batch of the Industrial and Financial Cooperation pilot was introduced so recently that no post-policy data fall within the study's time scope. As a result, the sample for this study is limited to cities from the initial two test batches. The interpolation method is used in data processing to accommodate missing values, and cities with significant missing data on important variables are eliminated.

5. Empirical Results

5.1. Descriptive Statistics

The first two batches of China's national Industrial and Financial Cooperation pilot cities provide a quasi-experimental setting for this study. To minimize confounding effects arising from the financial crisis and subsequent full-scale COVID-19 reopening, we use a sample of pilot and non-pilot cities covering 2014–2022. We scheduled the first batch's implementation for 2016 and the second batch's for 2020. To investigate the effects and underlying channels of the Industrial and Financial Cooperation pilot policy on the urban energy transition, a multi-period difference-in-differences model is built. Table 1 presents descriptive statistics for the primary variables.

Table 1. Descriptive Statistics

VARIABLES	(1) Observations	(2) Mean	(3) Std. Dev.	(4) Min	(5) Max
<i>SO2_intensity</i>	1,008	1.035	1.983	0.00177	23.89
<i>ln_pgdp</i>	1,008	11.14	0.463	9.763	12.24
<i>ind_upgrade</i>	1,008	1.235	0.637	0.262	5.516
<i>gov_size</i>	1,008	0.162	0.0599	0.0579	0.491
<i>fin_dev</i>	1,008	3.056	1.320	0.714	7.715
<i>ln_green_patent</i>	1,008	6.518	1.523	1.386	10.45

5.2. Parallel Trends Test

Figure 1 presents the parallel trends test after winsorizing the primary explanatory variable at the 1st and 99th percentiles. The vertical axis displays the estimated policy effects and associated 95% confidence intervals, while the horizontal axis tracks years in relation to policy implementation. The parallel trends assumption is supported by the statistical insignificance of all pre-policy coefficients. The coefficients stay positive once the policy is put into place, but starting in the third post-treatment year, their significance progressively decreases. This suggests that the Urban Sulfur Dioxide (SO₂) Emission Intensity was greatly raised by the Industrial and Financial Cooperation pilot. The COVID-19 pandemic's economic disruptions, which began in 2020 and probably counteracted some of the later-stage policy effects, may be partially responsible for the declining relevance.

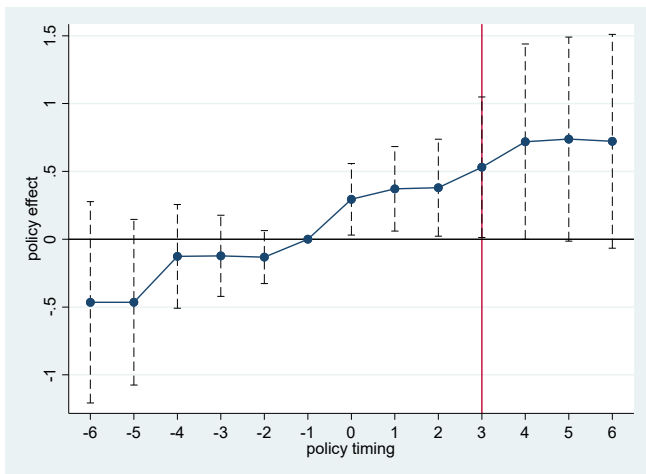


Figure 1. Parallel Trends Test

5.3. Baseline Regression Results and Analysis

Table 2 provides the baseline results. Column (1) excludes all entity-specific effects and control variables, using only the primary explanatory variable. At the 1% level of significance, the did coefficient is -0.9 . When the city and year fixed effects are added in column (2), the did coefficient rises to 0.444 and is significant at the 5% level. Ln GDP per capita, industrial structure upgrading, government size, financial development, and ln green patents are additional control variables that are included in column (3). This results in a did coefficient of 0.404 (significant at 5%), which is still positive. The did coefficient is notably negative when city fixed variables are not taken into account, however this probably indicates that treated cities already had lower emission intensity prior to the program.

The Industrial and Financial Cooperation pilot strategy actually raised urban Sulfur Dioxide (SO₂) Emission Intensity in the short term, since the coefficient turns strongly positive after adjusting for city and year fixed effects. This result seems a bit contradictory, and it can be explained by the production expansion effect; that happens when businesses get funding and then raise their output, so emissions rise faster than the speed of emission cuts per unit of output, and this pushes up emission intensity. Also, the economic recovery after COVID-19 happened around the same time as the second pilot batch, and this pattern may have been made bigger by the return of energy-hungry businesses; the short-term drop in emissions brought by energy-saving and low-carbon tech was overtaken by the rise in emissions from more industrial output. Looking at other control variables, the coefficient of green patents (*ln_green_patent*) is clearly negative, as expected, and this means that green technology innovation helps to lower emission intensity.

Table 2. Baseline Regression Results

VARIABLES	(1) SO2 intensity	(2) SO2 intensity	(3) SO2 intensity
<i>did</i>	-0.900^{***} (0.100)	0.444^{**} (0.191)	0.404^{**} (0.191)
<i>ln_pgdp</i>			1.007 (0.674)
<i>ind_upgrade</i>			1.049^{***} (0.334)
<i>gov_size</i>			9.753^{**} (3.838)
<i>fin_dev</i>			0.068 (0.171)
<i>ln_green_patent</i>			-0.692^{**} (0.311)
<i>Constant</i>	1.303^{***} (0.084)	0.903^{***} (0.072)	-8.873 (7.751)
<i>Observations</i>	1,008	1,008	1,008
<i>R-squared</i>	0.043	0.653	0.675
<i>City fixed effects</i>	NO	YES	YES
<i>Year fixed effects</i>	NO	YES	YES

Robust standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

5.4. Robustness Tests

We use two methods to filter the sample data in order to avoid extreme values and unique samples influencing the regression findings. After winsorizing all continuously measured variables at the extreme percentiles (1% and 99%), we first re-estimate the model. Second, cities that are directly under the central government are excluded; by doing this, the effect that their special resources and administrative standing might have on the results is made smaller. What the regressions from both tests gave is put in Table 3. After the extreme values are cut back (winsorizing), the number for *ln green patent w* in column (3) is -0.026 ; it stays negative, but it does not pass the usual significance cut-off, and the statistical precision is not as good. On the other side, the result

without any trimming of extremes, which is shown in Table 2, gives a coefficient of -0.692 , and this one is significant at the 1% level. This shift shows that the negative tie between green patents and SO₂ emission intensity is driven a bit by extreme values; in particular, a small group of cities that have high patent counts and low emissions are behind it. By taking away the noise of outliers through winsorizing, a stronger and more solid estimate is gotten, and this points to the direct effect of eco-innovation on SO₂ emission intensity being quite modest. For its effect of cutting emissions to show up fully, a longer line of passing-on effects is probably called for. After the directly administered cities are taken out, the findings stay in line with the baseline regression; this makes it clear that the conclusions are sturdy.

Table 3. Robustness Tests

VARIABLES	Winsorizing			Excluding municipality samples		
	(1)	(2)	(3)	(4)	(5)	(6)
	SO2 intensity w	SO2 intensity w	SO2 intensity w	SO2 intensity	SO2 intensity	SO2 intensity
<i>did</i>	-0.839***	0.491***	0.496***	-0.885***	0.455**	0.414**
	-0.084	-0.117	-0.115	-0.102	-0.195	-0.193
<i>ln pgdp w</i>			0.928			1.062
			-0.652			-0.671
<i>ind upgrade w</i>			0.655***			1.045***
			-0.248			-0.335
<i>gov size w</i>			7.745**			10.722***
			-3.465			-4.059
<i>fin dev w</i>			0.075			0.057
			-0.144			-0.173
<i>ln green patent w</i>			-0.026			-0.678**
			-0.173			-0.31
<i>Constant</i>	1.236***	0.840***	-11.606	1.298***	0.910***	-9.694
	-0.066	-0.043	-7.569	-0.084	-0.073	-7.749
<i>Observations</i>	1,008	1,008	1,008	990	990	990
<i>R-squared</i>	0.057	0.722	0.734	0.04	0.652	0.675
<i>City fixed effects</i>	NO	YES	YES	NO	YES	YES
<i>Year fixed effects</i>	NO	YES	YES	NO	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

5.5. Checking the Mechanism

To dig deeper into the possible paths through which the industrial and financial cooperation pilot policy influences city-level SO₂ emission intensity, a difference-in-differences regression was run, and the share of the secondary industry in GDP (*SE*) was taken as the variable to be explained. As can be seen in column (3) of Table 4, after fixed effects were controlled for and the control variables were put in, the *did* coefficient came out as 0.519 (p<0.05); this means the industrial sector got a fairly strong push to expand. Since the amount of pollution per unit of output is higher in industrial activities than in services, a rising share of the secondary industry directly drives up SO₂ emission intensity; through this, the positive policy effect that was found in the baseline regression can be better understood. In column (3), the number for structural upgrading (*ind upgrade w*) is -15.288 (p<0.01); this supports the idea that when the tertiary sector gets relatively larger, the secondary sector's share is pushed down, and it further backs up the existence of a structure effect. These results say that, in the short run, the pilot policy may for a while make environmental performance worse by

making industry take up a heavier weight and by giving a boost to production expansion; and this mechanism gives some evidence for the rebound effect that industrial and financial cooperation policies have on SO₂ emission intensity.

5.6. Heterogeneity Analysis

The heterogeneous impact of the industrial-financial cooperation pilot policy on urban energy structure transition is further looked at from two sides: green patent applications (Table 5) and resource-based cities (Table 6); these analyses give richer evidence for the conclusions

5.6.1. Green Patent Applications

In column (1), the regression results for the total number of green patent applications (the raw count) using the full sample are reported; after fixed effects are controlled for and control variables are added, the *did* coefficient comes out as 580.115 (p<0.01), and this means that in pilot cities, the absolute number of green patent applications was pushed up a lot by the policy.

Table 4. Share of Secondary Industry Value Added in GDP

	(1)	(2)	(3)
VARIABLES	SE	SE	SE
<i>did</i>	-2.970*** (0.690)	0.876** (0.354)	0.519** (0.215)
<i>ln_pgdp_w</i>			2.902 (1.790)
<i>ind_upgrade_w</i>			-15.288*** (0.594)
<i>gov_size_w</i>			-11.461*** (3.348)
<i>fin_dev_w</i>			0.541 (0.355)
<i>ln_green_patent_w</i>			0.369 (0.257)
<i>Constant</i>	44.413*** (0.322)	43.268*** (0.139)	27.486 (20.863)
<i>Observations</i>	1,008	1,008	1,008
<i>R-squared</i>	0.021	0.916	0.976
<i>City fixed effects</i>	NO	YES	YES
<i>Year fixed effects</i>	NO	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The model has a right-skewed distribution and extreme values, so the logarithmic form $\ln(1+\text{green_patent})$ is further used to do the estimation; as column (2) shows, with the same fixed effects and controls, the estimate is -0.067 ($p<0.01$), and it is clearly negative. What column (3) further makes clear is that after controlling for fixed effects and putting in control variables, the growth of green patent counts in resource-based cities does not get a strong push from the

policy. From these results, this conclusion can be reached: the absolute number of green patents was raised by the policy, but the relative growth rate of green patents in treated cities is clearly lower than that of the control group; the reason is that cities with a lot of patents are gathered in the treatment group, and in resource-based cities, the policy's role in lifting green patents stays unimportant.

Table 5. Green Patent Applications

	Green patent applications (full sample, count)	Log of green patent applications (full sample)	Log of green patent applications (resource-based cities)
	(1)	(2)	(3)
VARIABLES	<i>green_patent</i>	<i>ln_green_patent</i>	<i>ln_green_patent_res</i>
<i>did</i>	580.115*** -190.203	-0.067** -0.032	0.043 -0.079
<i>ln_pgdp</i>	466.817 -461.898	0.425*** -0.133	0.228 -0.211
<i>ind_upgrade</i>	1,081.746** -463.239	-0.083 -0.052	-0.336*** -0.117
<i>gov_size</i>	-6,666.770** -2,974.01	0.033 -0.731	-1.378 -1.788
<i>fin_dev</i>	344.467 -253.297	0.062* -0.032	-0.015 -0.108
<i>Constant</i>	-4,703.20 -5,659.72	1.71 -1.56	3.579 -2.549
<i>Observations</i>	1,008	1,008	225
<i>R-squared</i>	0.9	0.978	0.958
<i>City fixed effects</i>	YES	YES	YES
<i>Year fixed effects</i>	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

5.6.2. Cities with Resource Dependence and Cities without It

To carry out a test for Hypothesis H3, the data is split into two groups, one made up of resource-based cities and the other of non-resource-based cities, and the regressions are then run separately; the hypothesis says the policy effect should be stronger in resource-based cities. The results for the resource-based city group are put in Column (1) of Table 6; the did coefficient is 0.487, and it is not statistically significant, which shows that the industrial-financial cooperation pilot policy does not have a clear impact on SO₂ emission intensity in these cities. For the non-resource-based cities, as Column (2) shows, the did coefficient is 0.253, and it is positive and significant at the 1% level; this means the policy pushes up emission intensity by a notable amount in

cities that are not resource-based. This finding goes against Hypothesis H3, which had predicted a stronger effect in cities that depend heavily on resources.

One possible reason is that cities relying on resources already have high emission intensity, and their industrial base is rigid in structure; so, short-term financial support cannot quickly change their high-emission state. On the other side, cities that do not depend on resources have an industrial structure that is more flexible; in these cities, the policy stimulus triggers production expansion more easily, and through this, emission intensity is driven up. This finding brings out that the impact of industrial-financial cooperation policies is not the same across different city types, and it suggests that policy design should take up different ways that are made to fit different kinds of cities.

Table 6. Resource-based Cities and Non-resource-based Cities

	Resource-based cities	Non-resource-based Cities
	(1)	(2)
VARIABLES	<i>SO2_intensity_res</i>	<i>SO2_intensity_nonres</i>
<i>did</i>	0.487	0.253***
	-0.637	-0.098
<i>ln_pgdp</i>	2.263	-1.124*
	-1.369	-0.648
<i>ind_upgrade</i>	1.770***	0.261
	-0.639	-0.247
<i>gov_size</i>	27.299***	-1.119
	-8.455	-2.947
<i>fin_dev</i>	0.87	-0.078
	-0.743	-0.142
<i>ln_green_patent</i>	-2.037**	-0.08
	-0.887	-0.19
<i>Constant</i>	-20.352	13.837*
	-16.287	-7.204
<i>Observations</i>	225	783
<i>R-squared</i>	0.77	0.711
<i>City fixed effects</i>	YES	YES
<i>Year fixed effects</i>	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

6. Conclusion

In this research, the national pilot program on industrial and financial cooperation is taken as a quasi-natural experiment; a sample of 112 Chinese cities from 2014 to 2022 is used, and with a multi-period difference-in-differences method, we check the effect of the pilot on urban energy transition—this transition is measured by sulfur dioxide (SO₂) emission intensity—and we also look at how the effect differs across cities, that is, its heterogeneity.

6.1. Principal Findings

First, the baseline regression results show that the Industrial and Financial Cooperation pilot policy considerably raises rather than decreases the Sulfur Dioxide (SO₂) Emission Intensity of pilot cities after adjusting for city and year two-way fixed effects. This result defies theoretical

predictions. It implies that the policy may, in the short term, encourage industrial investment and production growth, resulting in a rebound effect in SO₂ emission intensity that counteracts the benefits of energy-saving and emission-reduction technologies.

Second, robustness assessments corroborate the strong resilience of the baseline results by demonstrating that the main conclusion has not altered much.

Third, the mechanism test shows that the Industrial and Financial Cooperation pilot increases investment and production activities in the industrial sector by offering financial support. This indirectly increases the intensity of SO₂ emissions by increasing the proportion of secondary industry in the economic structure. The main cause of the rise in SO₂ emission intensity is this structural shift, which is a tilt of the industrial structure toward industry.

Fourth, the relative growth rate of log-transformed green

patent applications is slower than that of the control group because high-patent cities are concentrated in the treatment group and have a larger patent base. The policy has no discernible impact on green patents in the resource-based city subsample. When considered collectively, the program has increased the total number of green patents, but the relative growth rate has slowed, and this rise has not yet resulted in noticeable reductions in emissions.

Fifth, heterogeneity analysis shows significant variation by city type: In cities not reliant on natural resources, the policy markedly raises SO₂ intensity; however, in resource-rich cities, the incentive effect on green innovation is not statistically significant. This pattern reflects the rigid transition of resource-dependent cities.

6.2. Research Restrictions and Prospects

There are a number of limitations to this study. First, because of data limitations, SO₂ emission intensity is the sole measure we adopt to capture the energy transition. The percentage of clean energy and energy consumption per GDP unit are examples of more direct measures that are not included. Second, the policy's long-term benefits on reducing emissions may not have been fully captured by the sample period (2014–2022); these effects need to be monitored further. Longer panel data and carbon accounting data could be used in future studies to further understand how Industrial and Financial Cooperation Policies affect the environment.

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