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Article

Keywords: Green Industrial Policy, Green Innovation Efficiency, Resource Misallocation, New Quality Productive Forces, Market Integration

Posted Date: April 8th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-7687172/v1

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Additional Declarations: No competing interests reported.

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Competing Interests: The authors whose names are listed immediately above certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

Data Availability: All data supporting the findings of this study are openly available. (https://drive.google.com/drive/folders/1ZZ6FXg-bF7zgNTzP0KNTl2KRX-WoFI5Ri?usp=drive_link)

Author Contribution: All authors contributed to the study conception and design. Conceptualization: Xing Xu; Methodology: Ming Zhang; Formal analysis and investigation: Ming Zhang; Writing - original draft preparation: Zhihong Zhang; Writing - review and editing: Xing Xu; Funding acquisition: Xing Xu; Resources: Ming Zhang; Supervision: Xing Xu.

Funding: This work received no funding.

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Abstract: Enhancing green innovation through industrial policy is a crucial task for local governments aiming to reconcile ecological sustainability with economic development. This study constructs a comprehensive dataset of 17,800 local green industrial policy documents and applies text mining techniques to analyze their structural features. Using Chinese city-level data from 2010 to 2021, we empirically investigate the effect of local green industrial policies on green innovation efficiency (GIE). The results indicate that these policies significantly improve regional GIE. Mechanism analysis reveals that green industrial policies enhance GIE by fostering new quality productive forces and alleviating resource misallocation. Moderation analysis further shows that market integration strengthens the positive effect of green industrial policies on GIE by enhancing policy coordination and reducing regional fragmentation. Heterogeneity analysis demonstrates that the effects of different types of green industrial policies vary across cities: executive policies are more effective in regions with superior resource endowments, higher environmental pressure, and advanced economic development, whereas guiding policies are more influential in smaller cities and non-priority environmental regions. These findings suggest that detailed, precise policies play a critical role in boosting GIE in major cities, while broader, guiding policies better stimulate green innovation in smaller cities. Overall, the study provides practical insights for tailoring policy design to local conditions, addressing structural tensions between ecological priorities and economic growth, and accelerating the modernization process in China.

JEL Classification: O31, O38, Q55, R11, H70

Keywords: Green Industrial Policy; Green Innovation Efficiency; Resource Misallocation; New Quality Productive Forces; Market Integration

1. Introduction

Balancing environmental protection with sustained economic growth has become a defining challenge for China's high-quality development agenda. As the sustainable development strategy and the "dual carbon" goals advance, the limitations of traditional policies that separately emphasize either environmental protection or economic growth have become increasingly evident. In response, green industrial policies, designed to jointly pursue environmental and economic objectives, have emerged as a central tool of local governments worldwide. In China, a series of initiatives, such as *Dongguan's Ecological Civilization Demonstration City Plan (2016–2025)* and *Ningbo's Carbon Peaking and Carbon Neutrality Innovation Action Plan (2021)*, exemplify how municipalities are leveraging regulation, planning, and incentives to create institutional conditions for green innovation. Green innovation serves as the crucial bridge between economic upgrading and ecological sustainability, and its efficiency has become a key measure of regional green development performance. Yet, despite its policy priority, the effectiveness of green industrial policies in fostering green innovation efficiency remains uneven across regions, due to weak institutional coordination and fragmented policy implementation.

These institutional and structural challenges underscore the urgency of evaluating the role of green industrial policies in driving green innovation efficiency. Many regions still face systemic barriers, such as underdeveloped low-carbon technologies, rigid energy structures, and insufficient integration of resources, capital, and technology, which collectively constrain overall green innovation efficiency. At the same time, persistent structural challenges, most notably high carbon emissions and market segmentation, limit the diffusion of green technologies and create significant regional disparities in green innovation outcomes. This raises a fundamental policy question: to what extent can local green industrial policies enhance green innovation efficiency, through which mechanisms, and with what heterogeneous impacts across cities?

China's policy discourse has increasingly emphasized coordinated governance and innovation-driven development as solutions to these challenges. The report of the 20th National Congress of the Communist Party of China called for simultaneously advancing carbon reduction, pollution control, ecological expansion, and economic growth. Similarly, President Xi Jinping highlighted

the need to "develop new quality productive forces guided by scientific and technological innovation" and to enhance the resilience of the modern industrial system. These directives frame green industrial policies as both a driver of technological upgrading and an institutional response to structural market failures. However, the decentralization of policy design means that local governments often adopt divergent approaches, leading to wide variation in policy content, implementation intensity, and effectiveness. Understanding these heterogeneous effects is crucial for assessing the value of green industrial policies and informing future reforms.

This study addresses these issues by empirically analyzing the effects of local green industrial policies on green innovation efficiency in China from 2010 to 2021. We classify local green industrial policies into executive policies, which emphasize concrete and actionable measures, and guiding policies, which provide broader orientation and regulatory direction. Using a comprehensive dataset of local policy documents, we show that such policies significantly improve regional green innovation efficiency, with both executive and guiding policies exerting positive impacts. We further find that the effects of green industrial policies exhibit a lag structure, reflecting the gradual nature of institutional change. Mechanism analysis reveals that green industrial policies promote efficiency partly by reducing resource misallocation and by enhancing new quality productive forces. Specifically, policies improve resource allocation and correct market failures, while simultaneously fostering technological upgrading and industrial restructuring. Heterogeneity analysis indicates that executive policies are particularly effective in large cities, environmental priority areas, and transportation hubs, while guiding policies exert stronger effects in smaller and less environmentally focused cities.

By establishing the positive and heterogeneous impacts of green industrial policies, this paper contributes to the literature on environmental regulation, innovation policy, and sustainable development. While prior studies have examined the definition, role, and impacts of green industrial policies, much of this work remains limited in scope. Existing studies often assess individual policies in isolation or focus on broad national initiatives, without systematically evaluating local-level policy interventions or their differentiated effects across regions. Similarly, research on green innovation efficiency has emphasized measurement methods and general determinants such as regulation, agglomeration, and resource allocation, but has paid less attention to how specific policy designs influence innovation outcomes through well-defined mechanisms.

This paper advances literature in three main ways. First, we construct a novel database of local green industrial policy documents and provide systematic evidence on their impact on green innovation efficiency. This approach moves beyond traditional single-policy evaluations and offers a new perspective on the role of industrial policy in shaping green innovation. Second, we distinguish between *executive policies* and *guiding policies* and investigate their respective impacts, as well as the mechanisms through which they operate. By highlighting the roles of reduced resource misallocation and enhanced new quality productive forces, we provide new evidence on how green industrial policies promote innovation efficiency. Third, we explore the heterogeneous effects of green industrial policies across city types, showing that executive policies are more effective in large, complex urban contexts, while guiding policies are more beneficial in smaller cities. This heterogeneity analysis expands the theoretical and empirical understanding of how local conditions shape the effectiveness of green industrial policies.

The remainder of the paper proceeds as follows. Section 2 reviews the related literature and situates this study within existing debates. Section 3 introduces the institutional and industrial background of green industrial policies in China. Section 4 outlines the empirical strategy and data sources. Section 5 presents empirical results, while Section 6 investigates the underlying mechanisms. Section 7 explores heterogeneity across different types of policies and city contexts. Section 8 concludes with a summary of findings and policy implications.

2. Literature Review

Research on green industrial policies has primarily focused on their conceptual definition, functional role, and policy impacts. At the definitional level, green industrial policies are often regarded as a derivative of traditional industrial policies, designed to reconcile the tension between economic growth and environmental protection. They rely on government interventions to guide structural transformation toward sustainability (Kong et al., 2024). Veugelers et al. (2024) highlight that green industrial policies facilitate green economic transformation by leveraging instruments such as tax incentives, subsidies, and support for technological innovation. In terms of their role, such policies are widely recognized for promoting technological advancement and inducing structural

adjustments in renewable energy sectors such as photovoltaics (Harrison et al., 2017). Comparative studies of India and China further reveal that the effectiveness of green industrial policies depends on aligning incentives with market demand, thereby facilitating sustainable industry transitions (Rogge and Reichardt, 2016). At the evaluation stage, studies have assessed impacts on green development, low-carbon technological innovation, industrial restructuring, and green innovation. For instance, Olsen and Fenhann (2008) employ text analysis of policy documents to examine their effects on regional green development. Ma et al. (2021) analyze policies such as green factory certifications, finding that such measures send credible green signals that promote firms' transformation. Tang et al. (2025) show that green finance policies channel capital into clean energy, fostering low-carbon innovation. Zhou et al. (2023) find that China's Green Finance Pilot Policy significantly enhances firms' total factor energy efficiency by guiding financial resources toward cleaner production and environmentally friendly technologies, especially in regions with stringent environmental oversight. Yet some studies caution against policy arbitrage, where firms exploit green mergers and acquisitions without genuine transformation (Yang and Chi, 2023), leading to short-sighted innovation behaviors that fail to raise innovation quality (Zhao et al., 2025). Overall, green industrial policies are found to encompass not only economic restructuring but also technological and institutional transformation, requiring coordination across stakeholders to achieve both environmental and developmental goals (Altenburg and Rodrik, 2017).

Research on green innovation efficiency has largely concentrated on measurement approaches and determinants. Green innovation efficiency captures the effectiveness of innovation when environmental constraints are considered, reflecting both technological progress and environmental performance (Zhang and Vigne, 2021). As a fusion of innovation-driven and green development, green innovation enables energy savings, pollution reduction, and socioeconomic benefits (Chien et al., 2021). Determinants studied include environmental regulation, industrial agglomeration, resource misallocation, human capital, financial development, and foreign direct investment. For example, Liu et al. (2023) argue that the mobility of capital, talent, and data improves the spatial allocation of innovation inputs. Resource misallocation, often induced by market failures or government distortions, is widely recognized as a key factor suppressing green innovation efficiency. Industrial agglomeration has also been found to generate scale and spillover effects that facilitate more efficient allocation of innovation resources (Li et al., 2025). Importantly, green industrial

policies are expected to play a correct role in addressing such distortions. On the measurement side, most studies employ Data Envelopment Analysis (DEA) models and their extensions. Bai et al. (2023) use a DEA-RAM model to calculate green innovation efficiency, while Wang et al. (2023) apply a super-efficiency SBM model to assess pilot innovative cities. Zhou et al. (2020) adopt a three-stage Malmquist-PNN index, and Wang et al. (2023) employ an EBM model to evaluate green innovation efficiency in manufacturing.

Despite this growing body of research, several gaps remain that motivate this study. First, existing evaluations of green industrial policies are often limited, relying on descriptive or narrow assessments of policy texts rather than systematic and fine-grained analyses. Second, few studies directly investigate the impacts of local green industrial policies on green innovation efficiency, leaving a lack of empirical evidence at the subnational level. Third, the mechanisms through which green industrial policies influence green innovation efficiency remain underexplored, and little is known about the specific transmission channels linking policies to innovation outcomes.

To address these gaps, this paper focuses on the role of local green industrial policies in shaping green innovation efficiency during 2010–2021. We build a comprehensive database of policy documents and employ text analysis to evaluate both executive policies and guiding policies. By doing so, the study makes three contributions. First, it introduces a new perspective by quantifying the impact of local green industrial policies, thus moving beyond the limitations of single-policy evaluations and providing robust evidence on how such policies enhance regional green innovation efficiency and support China's sustainable transformation. Second, it analyzes the structural features of policies and uncovers the mechanisms through which they improve innovation efficiency, thereby filling a gap in the literature on policy transmission channels. Third, it examines the moderating role of market integration and explores heterogeneous effects across different city characteristics, such as geographic location, economic development, and urban scale. By emphasizing these heterogeneities, the study extends the theoretical understanding of green industrial policies and identifies the conditions under which different types of policies are most effective.

3. Theoretical Framework and Research Hypotheses

Green industrial policies are a critical policy instrument through which governments reconcile economic growth with environmental protection. By promoting green technologies, enabling low-carbon transition, and fostering sustainable development, such policies create the institutional foundation for advancing green innovation efficiency (Harrison et al., 2017; Allan et al., 2021). This paper classifies local green industrial policies into guiding policies and executive policies. Guiding policies take the form of general principles that provide direction and orientation, whereas executive policies contain concrete, targeted, and operational measures with stronger enforceability. Together, this dual institutional framework aims to shift production functions toward environmental sustainability (Rodrik, 2014), with the central logic of internalizing environmental externalities (Aghion et al., 2021). Green innovation efficiency, in turn, reflects an economy's ability to achieve Pareto-optimal outcomes under resource constraints, combining technological and environmental efficiency (Färe et al., 2007). As global debates on green development intensify, local governments increasingly rely on industrial policies to incentivize innovation, support R&D, and guide firms toward greener technologies and practices (Bui et al., 2024; Gabor & Braun, 2025). Based on this logic, we propose the following hypothesis:

H1. *Local green industrial policies improve green innovation efficiency, with differential effects between executive policies and guiding policies.*

The first mechanism through which green industrial policies enhance green innovation efficiency is by alleviating resource misallocation. Resource misallocation arises when market imperfections or inappropriate government interventions distort the allocation of factors, preventing them from flowing to their most productive uses (Yang et al., 2022). By altering price signals, green industrial policies reshape firms' resource allocation decisions. From the perspective of resource dependence theory (Pfeffer & Salancik, 2015), strict policy regulation raises the cost of polluting and energy-intensive activities, forcing firms to restructure resource portfolios, retrain workers in green skills, retrofit outdated equipment, or shut down inefficient capacity. Simultaneously, incentive-based and regulatory instruments such as subsidies, tax breaks, or preferential procurement encourage incremental resources—including capital, technology, and skilled labor—to flow into green sectors. As capital and talent are released from high-carbon industries and redirected toward green innovation, overall resource utilization improves. The resulting factor reallocation provides

stronger support for green R&D and raises the environmental output per unit of input. Thus, we expect:

H2a. *Green industrial policies improve green innovation efficiency by reducing resource misallocation.*

The second mechanism is the cultivation of new quality productive forces. Green innovation serves as the crucial link between economic growth, environmental protection, and technological progress, and overcoming the high-carbon development path requires fostering new productive forces for the future. These forces, defined by technological innovation, talent development, and industrial upgrading, represent the central driver of high-quality growth (Liu and He, 2024). Green industrial policies play a key role in this process by enabling systemic restructuring of regional innovation capacity (Zhu and Tan, 2022). First, they empower technological innovation by funding green R&D, building public technology platforms, and supporting university–industry collaborations, thereby reducing uncertainty and accelerating breakthroughs. Second, they reshape the talent structure by promoting green-oriented education, training, and labor market clustering, while attracting high-skilled workers into green sectors. Third, they foster industrial upgrading by guiding investment, setting entry standards, and encouraging industrial clusters in high-tech, high-value-added, and low-carbon fields. These dynamics strengthen agglomeration effects, facilitate knowledge spillovers, and deepen specialization, all of which enhance innovation efficiency. As a result, breakthroughs in green technologies, the accumulation of skilled talent, and the clustering of advanced green industries generate a stronger innovation ecosystem and significantly improve green innovation efficiency. Hence, we hypothesize:

H2b. *Green industrial policies improve green innovation efficiency by fostering the development of new quality productive forces.*

Market integration plays an important moderate role in the effectiveness of green industrial policies. Regional market fragmentation impedes the diffusion of green technologies and innovation spillovers, while greater integration enhances the free flow and efficient allocation of goods, services, capital, labor, technology, and data across regions (Kebede, 2024). Higher levels of integra-

tion strengthen policy implementation by mitigating local protectionism and accelerating the dissemination of green technologies, knowledge, and talent (Nilsson et al., 2021). This reduces duplication of effort and increases spillovers from policy-supported innovation. Moreover, integrated markets allow capital and talent to reallocate more efficiently in response to policy signals, while intensifying inter-regional and inter-firm competition. Such competition compels local governments and firms to respond actively to green industrial policies, increasing investment in green R&D and improving innovation efficiency to maintain competitiveness. Finally, market integration supports the construction of a unified national market, narrowing gaps in policy execution across regions and enhancing the overall effectiveness of green transformation strategies. Therefore, market integration provides an institutional environment in which green industrial policies can exert stronger impacts on innovation efficiency through both factor reallocation and new productive forces. We therefore propose:

H3. *Market integration positively moderates the impact of green industrial policies on green innovation efficiency, such that higher levels of integration strengthen the positive effect of policies.*

4. Characteristics of Local Green Industrial Policies

The characteristics of local green industrial policies can be analyzed along temporal, spatial, and institutional dimensions. This section first examines the temporal and sectoral distribution of policies, then distinguishes between different institutional types of policy documents, and finally investigates regional variation across China.

4.1 Temporal and Institutional Features of Local Policies

Most existing studies extract proxies for green industrial policies from national or provincial Five-Year Plans. However, these planning documents mainly articulate broad strategic goals and directions for economic development and therefore provide limited information on specific policy instruments, enforcement mechanisms, and target groups. As a result, they fail to fully capture the institutional responses of cities. To address this gap, this paper follows the textual measurement approach and constructs a unique database of city-level policy texts from the PKU Law Database.

Using keyword combinations such as “industry,” “emission reduction,” “low carbon,” “green,” and “energy conservation,” we systematically searched all regulations issued between 2010 and 2021. From an initial set of 27,374 documents, we conducted a three-step screening process: first, removing provincial and national policies to retain only city-level documents; second, excluding industry standards or association guidelines without public legal effect; and third, dropping abolished or invalid documents to keep only “currently effective” texts. This procedure yielded 17,800 valid city-level green industrial policy documents.

From a sectoral perspective, these policies cover fourteen domains, including general regulations, business environment optimization, energy, construction, industrial management, fiscal policies, transportation, corporate governance, and pollution control. The high frequency of fiscal incentives, enterprise participation, and industrial collaboration demonstrates that local governments attach particular importance to incentive mechanisms and industrial coordination in promoting green development.

A key institutional distinction is between guiding policies and executive policies. Guiding policies typically take the form of regulations, measures, and plans, emphasizing institutional constraints and strategic orientation, and signaling governments’ long-term commitments to green development. Executive policies, by contrast, appear as notices, implementation schemes, or action plans, stressing task assignment and resource allocation to ensure short-term feasibility and timeliness. In practice, these two forms create a “guidance–execution” dual-track structure: guiding policies provide overarching direction and institutional frameworks, while executive policies ensure the translation of these frameworks into concrete regional and sectoral actions.

To further uncover differences between these two types of documents, we conducted a word-frequency analysis using Python and generated word clouds. Figures 1 and 2 present the word clouds for guiding policies and executive policies, respectively. The word clouds indicate that guiding policies are dominated by terms such as “green,” “reform,” “economy,” “industry,” and “promotion,” highlighting their emphasis on institutional guidance and long-term vision. In contrast, executive policies feature terms such as “plan,” “digitalization,” “action program,” and “innovation,” reflecting a stronger focus on process management and task execution. These patterns are further

summarized in Table 1, which presents the structural characteristics of the two policy types, including the dominant themes, functional focus, and typical linguistic features. Both the visual and tabular evidence confirm the complementary nature of the two policy types: guiding policies emphasize formality and authority, whereas executive policies prioritize operability and implementation details.

[INSERT Figures 1 & 2 HERE]

[INSERT Table 1 HERE]

4.2 Spatial Distribution of Local Policies

Beyond institutional structures, it is equally important to examine spatial variation in policy supply. Based on the 17,800 documents, we constructed a region–time distribution matrix of policy counts. The results reveal clear spatial heterogeneity across China. Eastern regions, characterized by higher concentrations of capital and technology and more mature institutional environments, issue a greater share of guiding policies that emphasize system building and long-term planning. By contrast, central and western regions, which are still catching up in terms of industrial upgrading and green transition, rely more heavily on executive policies that facilitate project implementation and short-term execution.

Figure 3 presents a heatmap of the number of green industry policies issued by each province, visually highlighting these regional patterns. The heatmap shows that eastern provinces such as Shandong, Jiangsu, and Henan tend to issue more guiding policies, emphasizing institutional design and long-term planning, whereas central and western provinces such as Guangdong, Zhejiang, and Guangxi rely more on executive policies, reflecting a stronger focus on implementation efficiency and project-driven approaches. These regional differences reflect variations in resource endowments, industrial structures, and governance capacities.

[INSERT Figure 3 HERE]

5. Methodology

5.1 Econometric Model

The empirical strategy exploits the staggered implementation of local green industry policies as an external shock to regional green innovation efficiency. To identify the causal impact of green industrial policies on local green innovation outcomes, we estimate the following baseline specification:

$$GIE_{it} = \alpha + \beta_1 Policy_{it} + \theta X_{it} + FE_{province} + FE_{year} + \varepsilon_{it} \qquad (1)$$

where i indices' cities and t indexes years. The dependent variable GIE_{it} measures regional green innovation efficiency. The key explanatory variable $Policy_{it}$ captures the intensity of local green industry policies, including the number of guiding policies and executive policies. The set X_{it} denotes control variables, discussed below. We include province and year fixed effects to account for time-invariant regional heterogeneity and common macroeconomic shocks. The coefficient of interest, β_1, measures the effect of local green industry policies on green innovation efficiency. A significantly positive estimate of β_1 would indicate that green industry policies foster regional green innovation efficiency.

5.2 Variable Construction and Measurement

The core variables in our analysis include the dependent variable GIE_{it}, the key policy variables, and a set of controls. We carefully construct each variable to align with established approaches in the environmental economics literature.

Green innovation efficiency (GIE) serves as the dependent variable. Following Wang et al. (2022), we adopt a super-efficiency slack-based measure (SBM) model to evaluate city-level efficiency. Traditional DEA models often suffer from slackness problems, while the SBM framework incorporates slack variables directly into the objective function and allows for the treatment of undesirable outputs (Wang and Hao, 2022). This provides more accurate measures of efficiency. Inputs include regional science and technology expenditure (capital input) and the number of employees engaged in scientific activities (labor input). Expected outputs include the number of granted green patents, investment in industrial pollution control, sales revenue of new products, and urban green coverage. Undesirable outputs consist of the "three industrial wastes," for which we construct a composite pollution index using an entropy weighting method.

$$\min(\omega)^* = \frac{1 + \frac{1}{\sigma}\sum_{i=1}^{\sigma}\frac{s_i^-}{A_{i0}^t}}{1 - \frac{1}{\tau+\varphi}\left(\sum_{r=1}^{\tau}\frac{s_r^+}{B_{r0}^t} + \sum_{k=1}^{\varphi}\frac{s_k^-}{C_{k0}^t}\right)} \quad (2)$$

$$s.t\begin{cases} A_{i0}^t \geq \sum_{t=1}^{T}\sum_{j=1,\neq 0}^{n}\mu_j^t A_{ij}^t - s_i^- i = 1,2,\cdots,\sigma \\ B_{r0}^t \geq \sum_{t=1}^{T}\sum_{j=1,\neq 0}^{n}\delta_j^t\ B_{rj}^t + s_r^+ r = 1,2,\cdots,\tau \\ C_{k0}^t \geq \sum_{t=1}^{T}\sum_{j=1,\neq 0}^{n}\epsilon_j^t\ C_{kj}^t - s_k^- k = 1,2,\cdots,\varphi \\ s_i^- \geq 0(\forall i), \mu_j^t \geq 0(\forall j), s_r^+ \geq 0(\forall r), s_k^- \geq 0(\forall k) \end{cases}$$

Local green industrial policies constitute the key explanatory variables. Drawing on Zhou and Zhang (2023), we distinguish between guiding policies, which emphasize long-term planning and institutional guidance, and executive policies, which focus on short-term implementation and operational tasks. We construct these measures from the number of policy documents issued in each city-year, using data retrieved from a comprehensive legal database.

Control variables capture economic, demographic, and institutional characteristics. Industrial upgrading is proxied by the ratio of tertiary to secondary industry value added (*IC*). Government intervention (*GI*) is measured by the ratio of local fiscal expenditure to GDP (Liao and Zhang, 2023). We also include log GDP per capita (*LnGDP*) to capture economic development, log population density (*Lnpeo*) to measure demographic pressure, education expenditure as a share of fiscal expenditure (*Edu*) to proxy human capital, and science and technology expenditure as a share of fiscal expenditure (*Tech*) to capture innovation capacity (Xu et al., 2024; Huang et al., 2021). Summary statistics are reported in Table 2.

[INSERT Table 2 HERE]

5.3 Data Sources

The sample period is set from 2010 to 2021. In 2009, the State Council of China announced the 2020 greenhouse gas emission reduction target, and according to our retrieval from the PKU Law Database, the issuance of local green industrial policies began in 2010. Therefore, 2010 is chosen

as the starting year. Cities in Tibet, Taiwan, Macau, and Hong Kong are excluded due to severe data limitations.

Our data are drawn from three primary sources:

(1) PKU Law Database.

The PKU Law Database contains a comprehensive collection of Chinese legal and regulatory documents since 1950[1], covering national and local regulations, legislative records, and subcategories with detailed information on effectiveness, classification, issuing authorities, and legal status. Using keywords such as industry, emission reduction, low carbon, green, and energy saving, we retrieved 17,800 local regulations issued between 2010 and 2024. Several steps were taken to refine the dataset. First, because our analysis is conducted at the city level, provincial-level regulations were excluded. Second, we restricted the sample to policies with legal authority, excluding group and industry regulations that apply only within associations. Third, since green industrial policies may be classified as invalid, revised, amended, or currently effective, we excluded those that were no longer valid.

(2) China Research Data Service Platform (CNRDS).

Data used to construct green innovation efficiency—including regional science and technology expenditure, number of R&D personnel, granted green patents, investment in industrial pollution control, new product sales, urban green coverage, and industrial "three wastes"—are obtained from the CNRDS database[2].

(3) China Statistical Yearbook and Provincial Statistical Yearbooks.

We obtain additional variables on resource misallocation, new quality productivity, and market integration from the China Statistical Yearbook and provincial yearbooks. Resource misallocation

[1] Peking University Law Database: https://www.pkulaw.com/law?way=topGuid.

[2] China Research Data Service Platform (CNRDS) Database: https://www.cnrds.com/Home/Login.

is measured following Hsieh and Klenow (2009) and Liu and Xia (2023) using a Cobb–Douglas production function[3]

New quality productivity is constructed following Han et al. (2024) using a three-dimensional evaluation system[4], covering new laborers, new labor materials, new labor objects (substantive factors), as well as new technology, organizational innovation, and data factors (penetrative factors). Indicators are standardized, entropy weights are calculated, and an aggregate index is derived.

Market integration is measured based on Fan (2011) using relative price variance across regions. We use sequential commodity price indices for products such as grain, pharmaceuticals, clothing and footwear, cultural and sports goods, beverages and tobacco, fuels, newspapers and magazines, and daily necessities[5]. The log first-difference of relative prices is computed, absolute values are taken to avoid order sensitivity, and product-level heterogeneity is controlled by demeaning. The relative price variance is then aggregated across goods and regions to construct the market integration index.

6. Empirical Analysis

6.1 Baseline Results

Table 3 presents the baseline regression results on the effect of local green industrial policies on green innovation efficiency. The coefficients of both executive policies and guiding policies are

[3] This paper calculates the marginal output of capital and labor ($\alpha Y_{it}/K_{it}$ and $\beta Y_{it}/L_{it}$) based on the Cobb-Douglas production function （$\ln Y_{it}=c+\alpha \ln K_{it}+\beta \ln L_{it}+\varepsilon_{it}$）. Factor market distortion is defined as the deviation of marginal output from factor prices: capital distortion: $distK_{it}=|\alpha Y_{it}/(r_{it}K_{it})-1|$and labor distortion: $distL_{it}=|\beta Y_{it}/(w_{it}L_{it})-1|$.

[4] The three-level indicators of new quality productivity are primarily divided into physical factors and pervasive factors. Physical factors include new workers, new means of production, and new objects of labor, while pervasive factors include new technologies, production organizations, and data elements.

[5] Commodities include: food, medicine, clothing, shoes, and hats, cultural and sports supplies, beverages, tobacco, alcohol, fuel, books, newspapers, magazines, and daily necessities.

positive and statistically significant, suggesting that local policies play an important role in enhancing cities' green innovation efficiency. Specifically, the coefficient of executive policies is 0.005 in column (1) and 0.007 in column (2), both significant at the 5% level, indicating that the issuance of one additional executive policy raises green innovation efficiency by about 0.5–0.7 percentage points on average. Similarly, the coefficients of guiding policies are 0.004 in columns (3) and (4), significant at the 5% and 10% levels, respectively, implying that one additional guiding policy increases green innovation efficiency by about 0.4 percentage points. These results suggest that executive policies, which contain concrete action plans and implementation measures, reduce policy uncertainty and send clearer signals to market participants, thereby encouraging firms to increase investment and execution capacity in green innovation. By contrast, guiding policies rely more on setting environmental standards, industrial regulations, and legal constraints, which exert binding pressure on firms' production and R&D activities and thus promote innovation from a regulatory perspective.

Among the control variables, industrial upgrading and population density exhibit significant effects on green innovation efficiency. Industrial upgrading has coefficients of 0.014 and 0.012 in columns (1) and (3), both significant at the 5% level, indicating that structural upgrading is an important driver of green innovation efficiency. Population density has coefficients of 0.015 and 0.014 in columns (1) and (3), significant at the 10% level, suggesting that larger population size may enhance efficiency through labor supply, market expansion, and innovation networks.

[INSERT Table 3 HERE]

6.2 Robustness Tests

To verify the robustness of the baseline findings, we replace the dependent variable with alternative measures of green innovation. Specifically, we use the logarithm of the number of granted green invention patents (*Lngrv*) and green utility model patents (*Lngrm*) as dependent variables. Table 4 reports the results. When the dependent variable is green invention patents (column 1), one additional executive policy raises the number of patents by 15.8% on average. When the dependent variable is green utility model patents (column 2), one additional executive policy increases the number by 14.5%. Furthermore, when the total number of local green industrial policies (*LnGIP*)

is used as the explanatory variable (column 3), a 1% increase in policy issuance raises green innovation efficiency by 0.6% on average. The direction and significance of these results are consistent with the baseline estimates, reinforcing the conclusion that local green industrial policies robustly promote green innovation efficiency.

[INSERT Table 4 HERE]

6.3 Endogeneity Tests

Although the results above demonstrate a positive relationship between local green industrial policies and green innovation efficiency, potential endogeneity concerns remain. Policy issuance may not be exogenous: cities with higher innovation efficiency could be more likely to issue green policies, generating reverse causality. In addition, omitted variables such as local government capacity, environmental awareness, or firms' R&D capabilities may simultaneously affect both policy issuance and innovation efficiency, leading to biased estimates. Selective policy adoption depending on economic development stages or strategic considerations could also generate sample selection bias.

To address these concerns, we first use lagged values of executive and guiding policies as explanatory variables. Table 5 shows that the coefficient of lagged executive policies is 0.006, significant at the 5% level, and the coefficient of lagged guiding policies is 0.007, also significant at the 5% level. This finding indicates that policy effects are not merely contemporaneous but persist over time, suggesting that the issuance of local policies continues to influence green innovation efficiency in subsequent periods.

[INSERT Table 5 HERE]

We further apply the system GMM estimator to mitigate endogeneity concerns. Table 6 reports that the coefficient of executive policies is 0.010, significant at the 5% level, while the coefficient of guiding policies is 0.015, positive though only weakly significant at the 10% level. These estimates are consistent in sign and magnitude with the baseline and lagged results. The Sargan over-identification test and Arellano–Bond tests for first- and second-order serial correlation confirm the validity of the instruments and the absence of second-order autocorrelation. Taken together, these results suggest that the positive effect of local green industrial policies on green innovation

efficiency is unlikely to be driven by endogeneity and remains robust across alternative specifications.

[INSERT Table 6 HERE]

7. Mechanisms: How Green Industrial Policies Influence Green Innovation Efficiency

7.1 Mediation Analysis

We first examine whether local policies affect green innovation efficiency (GIE) through the channels of resource allocation distortion and innovation-oriented new productivity. Resource allocation distortion (Allocation) reflects inefficiencies in factor use that arise from government intervention, institutional rigidities, or firm heterogeneity. By contrast, innovation-oriented new productivity (INP) emphasizes the contribution of new drivers such as digitalization, advanced manufacturing, and technological upgrading to sustainable growth. To test these mediating channels, we estimate a set of models where executive policies and guiding policies serve as the core explanatory variables, and Allocation and INP enter as mediators. While stepwise mediation methods often raise concerns about causal identification, our discussion follows the framework of Jiang (2020), with the focus placed on how green industrial policies causally transmit their effects to innovation outcomes.

The mediating effect of resource misallocation is modeled as:

$$Allocation_{it} = \varphi + \sigma_1 Policy_{it} + \rho X_{it} + FE_{province} + FE_{year} + \varepsilon_{it} \qquad (3)$$

$$GIE_{it} = \alpha + \beta_1 Policy_{it} + \beta_2 Allocation_{it} + \theta X_{it} + FE_{province} + FE_{year} + \varepsilon_{it} \qquad (4)$$

Similarly, the mediating effect of new quality productive forces is specified as:

$$INP_{it} = \varphi + \sigma_1 Policy_{it} + \rho X_{it} + FE_{province} + FE_{year} + \varepsilon_{it} \qquad (5)$$

$$GIE_{it} = \alpha + \beta_1 Policy_{it} + \beta_2 INP_{it} + \theta X_{it} + FE_{province} + FE_{year} + \varepsilon_{it} \qquad (6)$$

Here, $Allocation_{it}$ and INP_{it} denote the level of resource misallocation and new quality productive forces for city i in year t, respectively. All other variables are consistent with equation (1). These

models allow us to quantify the extent to which executive policies affect GIE directly and indirectly through improvements in resource allocation efficiency and the enhancement of INP.

Table 7 reports the mediation results for resource allocation distortion. Columns (1) and (3) show that executive policies significantly reduce Allocation. The estimated coefficient of –0.023 is significant at the 1% level, implying that the issuance of one additional executive policy reduces resource misallocation by 2.3 percentage points on average. Column (3) further indicates that lower Allocation increases GIE by 1.8 percentage points, and executive policies remain significant in the full specification, suggesting a partial mediation effect. Columns (2) and (4) report the results for guiding policies. The coefficient of guiding policies on Allocation is –0.014, significant at the 1% level, showing that guiding policies also alleviate misallocation. In column (4), the reduction in Allocation improves GIE by 1.7 percentage points, but the direct effect of guiding policies becomes insignificant. This pattern suggests that the effect of guiding policies on innovation efficiency is transmitted almost entirely through the reduction of resource misallocation, resembling a near-complete mediation effect.

[INSERT Table 7 HERE]

Table 8 examines the mediating role of INP. Columns (1) and (3) show that executive policies significantly enhance INP, with a coefficient of 0.004 at the 5% level. Column (3) indicates that higher INP strongly promotes GIE, with a coefficient of 0.284 at the 1% level, implying that a one-unit increase in INP raises GIE by about 28.4 percentage points. Executive policies remain significant in this model, indicating that they affect innovation efficiency partly through improving INP, a classic partial mediation effect. In contrast, columns (2) and (4) show that guiding policies do not significantly raise INP. However, INP itself exerts a strong positive effect on GIE, with a coefficient of 0.258 at the 1% level, while the direct effect of guiding policies on GIE remains positive and significant at the 5% level. This suggests that guiding policies influence innovation efficiency through other mechanisms beyond INP, resulting in only a weaker partial mediation effect compared with executive policies.

[INSERT Table 8 HERE]

7.2 Moderation Analysis

We next assess whether the effect of local green industrial policies on innovation efficiency depends on the degree of market integration. Market integration (*Minteg*) facilitates policy effectiveness by lowering barriers to factor flows, reducing market segmentation, and accelerating the diffusion of technologies. To test for such moderating effects, we extend the baseline model by including the interaction between policies and *Minteg*. To examine this potential moderation effect, we incorporate the market integration index into our framework and extend equation (1) as follows:

$$GIE_{it} = \alpha + \beta_1 Policy_{it} + \beta_2 Minteg_{it} + \beta_3 Policy_{it} * Minteg_{it} + \theta X_{it} + FE_{province} + FE_{year} + \varepsilon_{it} \quad (7)$$

Here, $Minteg_{it}$ represents the level of market integration for city i in year t, and all other variables are defined as in equation (1). This model allows us to evaluate whether the effectiveness of executive and guiding policies in enhancing GIE varies systematically with the degree of market integration, capturing potential synergistic effects between policy interventions and regional market conditions.

Table 9 presents the results. Column (1) shows that the interaction between executive policies and *Minteg* is positive and significant at the 5% level, with a coefficient of 0.002. This finding indicates that greater market integration amplifies the effect of executive policies on innovation efficiency, with one additional unit of integration enhancing the policy effect by 0.2 percentage points. The result highlights the complementarity between executive policies and a well-integrated market environment: when integration is higher, executive policies are more effective in stimulating innovation. Column (2) shows similar evidence for guiding policies, where the interaction with *Minteg* also carries a coefficient of 0.002, significant at the 5% level. This implies that guiding policies, although broader in scope and direction, are also more effective in promoting innovation under conditions of greater market integration. Overall, these findings underscore that policies and market environment are not substitutes but rather complements in driving green innovation efficiency.

8. Heterogeneity Analysis

The effectiveness of green industrial policies is unlikely to be uniform across regions, given variations in economic fundamentals, urban functions, development stages, and policy enforcement environments. Such heterogeneity makes it essential to identify the boundary conditions under which these policies enhance green innovation efficiency. By exploring heterogeneous effects

across different regional, institutional, and developmental contexts, we can better understand the scope of policy effectiveness and provide empirical guidance for tailored policymaking.

The first source of heterogeneity arises from systematic regional differences between the South, the North, and the transitional "Hu Line" area. These regions differ markedly in natural endowments, industrial structure, marketization, and development stage. Table 10 reports the results of the Hu Line division test. Executive policies significantly enhance green innovation efficiency in both the South (coefficient = 0.005, significant at the 10% level) and the North (0.006, significant at the 5% level), but the effect is insignificant along the Hu Line. Guiding policies exhibit a similar pattern. These findings indicate strong spatial heterogeneity in policy effectiveness. The South and North, as China's economic cores, provide a more favorable environment for policy implementation due to their established markets, industrial foundations, and clear transformation needs. In contrast, the Hu Line area often functions as a transitional zone with ambiguous development positioning and weaker market or industrial support, limiting the effectiveness of policy intervention.

A second dimension of heterogeneity concerns environmental regulatory pressure. Key environmental protection cities face stricter targets and stronger oversight, which may make local governments and firms more responsive to policies promoting green innovation. Table 11 shows that executive policies significantly improve green innovation efficiency in key environmental protection cities (coefficient = 0.014, significant at the 5% level), with effects much stronger than in non-key cities. Conversely, guiding policies are more effective in non-key cities (0.001, significant at the 5% level), but not in key cities. This contrast reflects differentiated policy demands under varying regulatory pressures. In key cities subject to "hard constraints," executive policies are more effective because they channel resources directly into technological upgrading and equipment renewal to meet stringent environmental requirements. In non-key cities, where constraints are looser and firms may lack intrinsic incentives for green innovation, guiding policies can play a more meaningful role.

The third heterogeneity dimension lies in urban connectivity. Transportation hub cities benefit from high levels of factor mobility, which accelerates knowledge spillovers, technology diffusion, and market responses. As shown in Table 12, executive policies have significantly stronger effects in hub cities compared to non-hub cities, while guiding policies are more effective in non-hub

cities. This finding underscores the importance of factor flows and market connectivity in amplifying policy impacts. In hub cities, resource inflows, technological diffusion, and market signals spread rapidly, enabling executive policies to trigger scale economies and network-based collaborative innovation. By contrast, in less connected non-hub cities, guiding policies can compensate for limited factor mobility by providing stable long-term orientation.

Finally, city size shapes the institutional environment for innovation. Large and medium-sized cities benefit from stronger agglomeration economies, richer innovation inputs, and more developed supporting services. Table 13 shows that executive policies significantly improve green innovation efficiency in large and medium-sized cities (coefficient = 0.021, significant at the 5% level), but not in smaller cities. Conversely, guiding policies are more effective in smaller cities (0.005, significant at the 5% level), but insignificant or even negative in larger cities. These results suggest that urban scale creates divergent innovation ecosystems that align differently with policy tools. Large and medium-sized cities can more effectively absorb resource inputs mobilized by executive policies and coordinate large-scale projects within complex innovation networks. In smaller cities, however, the relatively simple innovation system may benefit more from the long-term orientation and normative guidance provided by guiding policies.

[INSERT Table 10 HERE]

[INSERT Table 11 HERE]

[INSERT Table 12 HERE]

[INSERT Table 13 HERE]

9. Conclusions and Policy Implications

This study provides robust empirical evidence on the impact of local green industrial policies on green innovation efficiency (GIE) in China over the period 2010–2021. Our main findings indicate that both executive policies and guiding policies significantly enhance regional GIE, with observable time-lagged effects. Mechanism analysis further shows that local green industrial policies

improve GIE partly through alleviating resource misallocation and fostering new quality productive forces (INP). Specifically, policy implementation reduces resource allocation distortions, thereby indirectly enhancing GIE by optimizing resource deployment and mitigating market failures. Simultaneously, local green industrial policies positively influence INP, which in turn strengthens GIE, suggesting that policy-driven green innovation contributes not only to environmental objectives but also to economic structural transformation and the development of emerging industries. Heterogeneity analysis reveals substantial variation in policy effectiveness across cities: executive policies are particularly effective in key environmental cities, transportation hubs, and large- and medium-sized cities, whereas guiding policies exert stronger effects in smaller cities and non-key environmental cities. This indicates that highly detailed and precise policy instruments are crucial for promoting GIE in major urban centers, while broader, guiding policies better stimulate green innovation in smaller cities. Overall, local green industrial policies enhance GIE through both direct policy guidance and indirect channels, including improved resource allocation and strengthened INP.

Based on these findings, several policy implications emerge. First, strengthening top-level policy design with a forward-looking orientation is essential to transform ecological constraints into innovation incentives. Given the time-lagged effects of policy, local governments should move beyond short-term, immediate-effect thinking and formulate medium- to long-term green industrial strategies that align with the specific needs and bottlenecks of regional green innovation. Policy design should incorporate realistic assessments of long-term effects, and regular monitoring and ex-post evaluations should be institutionalized to dynamically adjust policies, ensuring that policy benefits are fully realized despite temporal lags.

Second, building a modern foundation for INP requires coordinated and systematic policy instruments. Market-oriented reforms should remove institutional barriers that hinder the flow of capital, talent, and technology into green sectors. Developing well-functioning green technology and carbon trading markets can leverage price signals to correct resource misallocation. At the same time, strategic investments and policy support in digitally enabled, intelligent, and green sectors are essential to strengthen innovation infrastructure and enhance intellectual property protection and utilization, thereby fostering INP and supporting green innovation.

Third, promoting regional coordination in modern governance is critical for optimizing resource allocation and reducing market distortions. Policies should create market environments and governance frameworks conducive to efficient resource deployment, lowering transaction costs and addressing market failures. This includes optimizing fiscal and financial support for green industries through a combination of subsidies, tax incentives, risk compensation, and green public procurement to attract private investment into sustainable innovation. Regional collaboration mechanisms should also be strengthened to enable efficient factor mobility, such as cross-regional green technology transfer platforms, industrial alliances, and ecological compensation systems, thereby mitigating policy fragmentation and achieving resource complementarities and scale effects.

Finally, implementing differentiated and precise policy strategies can enhance policy effectiveness across cities of varying characteristics. Detailed, actionable executive policies should focus on complex urban environments, high-end green industrial upgrading, green infrastructure development (e.g., smart transport, low-carbon buildings), and the attraction and aggregation of advanced green innovation factors. In parallel, broad, guiding policies should provide overarching direction, cultivate supportive environments, stimulate intrinsic innovation incentives, and offer foundational support, allowing for flexibility in local implementation. Careful coordination between executive and guiding policies ensures complementarity, with guiding policies providing the strategic framework for executive measures while preventing potential policy conflicts.

Despite these contributions, this study has several limitations that open avenues for future research. First, the analysis is based on Chinese city-level data, and while the findings are relevant for understanding green industrial policy in emerging economies, their generalizability to other institutional and market contexts may be limited. Second, the study primarily focuses on the short- to medium-term effects of policy on GIE and its mechanisms; long-term impacts on structural transformation and broader economic outcomes remain to be explored. Third, although the study considers heterogeneity across regions and city types, additional dimensions such as firm ownership structure, industry characteristics, and international exposure could further illuminate the differential impacts of green industrial policies. Future research could extend this analysis by integrating cross-country comparisons, firm-level heterogeneity, and more granular measures of technological change, providing deeper insights into the conditions under which green industrial policies are most effective.



Figure 1: Executive Policies Documents Word Cloud



Figure 2: Guiding Policies Documents Word Cloud

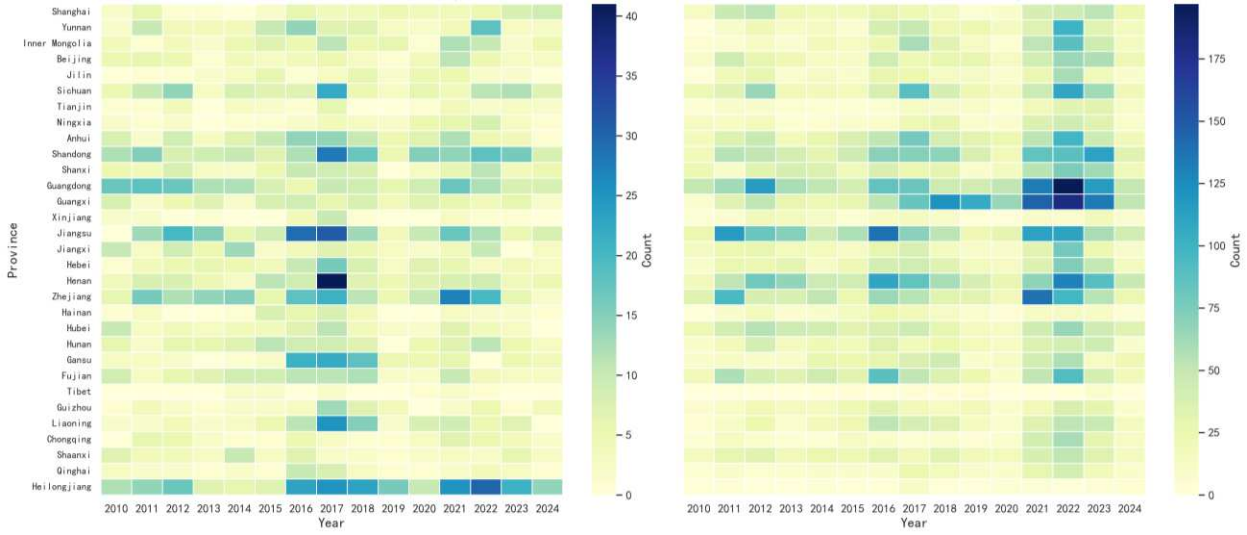


Figure 3: Heatmap of Policy Counts by Province for Executive and Guiding Policies

Table 1: Structural Characteristics of Local Green Industry Policies

Characteristics	**Local Guiding Policies**	**Local Executive Policies**
Keywords	Green, economy, reform, industry, promotion	Informatization, reform, plan, action plan, innovation
Textual Features	Formalized, authoritative, emphasizing direction and guidance	Practical, operational, emphasizing specific tasks and implementation details
Focus Areas	Overall framework of green economy, ecological protection	Technological promotion, digitalization, regional projects
Scope of Application	Aimed at macro-level and long-term planning	Aimed at regional-level and short-term execution

Table 2: Summary Statistics

	(1)	(2)	(3)	(3)	(4)
VARIABLES	N	$Mean$	SD	Min	Max
GIE	2183	0.017	0.055	0.000	1.000
$PolicyWorking$	2183	3.157	0.709	0.693	4.710
$PolicyNormative$	2183	1.905	0.655	0.000	3.434
IC	2183	1.001	0.503	0.175	5.348
GI	2183	0.179	0.074	0.044	0.675
$Lnpeo$	2183	5.988	0.733	1.792	7.882
Edu	2183	0.179	0.038	0.046	0.356
$LnGDP$	2183	10.812	0.541	9.219	13.056
$Tech$	2183	0.020	0.019	0.001	0.207
$Allocation$	2183	0.340	0.168	0.004	1.000
INP	2183	0.057	0.076	0.003	0.618
$Minteg$	2183	16.449	2.309	11.000	23.236

Table 3: Baseline Regression Results

	(1)	(2)	(3)	(3)
VARIABLES	GIE_{it}	GIE_{it}	GIE_{it}	GIE_{it}
$PolicyWorking$	0.005**	0.007**		
	(0.002)	(0.003)		
$PolicyNormative$			0.004**	0.004*
			(0.002)	(0.002)
IC	0.014**	0.004	0.012*	0.012*
	(0.006)	(0.009)	(0.006)	(0.007)
GI	0.026	-0.062	0.019	0.021
	(0.046)	(0.045)	(0.046)	(0.043)
$Lnpeo$	0.015*	0.011	0.014*	0.014*
	(0.008)	(0.007)	(0.008)	(0.008)
Edu	0.052	0.133	0.064	0.065
	(0.078)	(0.097)	(0.075)	(0.075)
$LnGDP$	0.012*	-0.011	0.009	0.011
	(0.007)	(0.008)	(0.006)	(0.007)
$Tech$	-0.183	-0.203	-0.204	-0.204
	(0.169)	(0.165)	(0.170)	(0.170)
Observations	2183	2183	2183	2183
Adjusted R-squared	0.298	0.310	0.291	0.291
Industry FE	NO	YES	YES	YES

Years FE	NO	NO	YES	YES

Note: Clustered standard errors at the city level are reported. *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Results of test on replacement variables

	(1)	(2)	(3)	(3)	(3)
VARIABLES	$Lngrv$	$Lngrv$	$Lngrm$	$Lngrm$	GIE_{it}
$PolicyWorking$	0.158***		0.145*		
	(0.027)		(0.082)		
$PolicyNormative$		0.271***		0.077***	
		(0.022)		(0.015)	
$LnGIP$					0.006**
					(0.002)
IC	0.195*	0.128	0.252	0.651***	0.014**
	(0.109)	(0.094)	(0.257)	(0.076)	(0.006)
GI	3.716***	3.361***	-0.718	2.855***	0.022
	(0.839)	(0.808)	(1.245)	(0.711)	(0.046)
$Lnpeo$	0.119	0.111	0.558***	0.013	0.014*
	(0.096)	(0.087)	(0.094)	(0.125)	(0.008)
Edu	1.392	1.290	2.445	-1.523*	0.050
	(1.186)	(1.203)	(1.598)	(0.824)	(0.077)
$LnGDP$	1.535***	1.457***	1.181***	1.640***	0.012*
	(0.117)	(0.107)	(0.175)	(0.088)	(0.007)
$Tech$	6.051***	6.160***	15.718***	2.377	-0.181

	(1.760)	(1.747)	(3.709)	(1.651)	(0.168)
Observations	2183	2183	2183	2183	2183
Adjusted R-squared	0.904	0.909	0.689	0.931	0.364
Industry FE	YES	YES	YES	YES	YES
Years FE	YES	YES	YES	YES	YES

Table 5: Results of endogeneity test of lagged terms

	(1)	(2)	(3)
VARIABLES	GIE_{it}	GIE_{it}	GIE_{it}
$PolicyWorking$	0.006**		
	(0.002)		
$PolicyNormative$		0.007**	
		(0.003)	
$LnGIP$			0.009***
			(0.003)
Industry FE/ Industry FE/Controls	YES	YES	YES
Observations	2183	2183	2183
Adjusted R-squared	0.289	0.292	0.292

Table 6: System GMM endogeneity test results

	(1)	(2)	(3)
VARIABLES	GIE_{it}	GIE_{it}	GIE_{it}
$PolicyWorking$	0.010**		
	(0.004)		
$PolicyNormative$		0.015	
		(0.012)	
$LnGIP$			0.012**
			(0.005)
Industry FE/ Industry FE/Controls	YES	YES	YES
Observations	2183	2183	2183

Table 7: Mediating effect of resource allocation distortion

VARIABLES	(1) $Allocation$	(2) $Allocation$	(3) GIE_{it}	(4) GIE_{it}
$PolicyWorking$	-0.023***		0.007**	
	(0.005)		(0.003)	
$PolicyNormative$		-0.014***		0.002
		(0.004)		(0.002)
$Allocation$			0.018**	0.017**
			(0.009)	(0.009)
Industry FE/ Industry FE/Controls	YES	YES	YES	YES
Observations	2183	2183	2183	2183
Adjusted R-squared	0.765	0.379	0.769	0.377

Table 8: Mediating effect of new quality productivity

VARIABLES	(1) INP	(2) INP	(3) GIE_{it}	(4) GIE_{it}
$PolicyWorking$	0.004**		0.007***	
	(0.002)		(0.002)	
$PolicyNormative$		0.000		0.004*
		(0.001)		(0.002)
INP			0.284***	0.258***
			(0.058)	(0.057)
Industry FE/ Industry FE/Controls	YES	YES	YES	YES
Observations	2183	2183	2183	2183
Adjusted R-squared	0.471	0.372	0.949	0.369

Table 9: Analysis of the regulatory effect of market integration

	(1)	(2)
VARIABLES	GIE_{it}	GIE_{it}
$Minteg$	-0.007***	-0.005***
	(0.003)	(0.002)
$PolicyWorking$	0.023*	
	(0.014)	
$PolicyNormative$		0.030**
		(0.014)
$Minteg * PolicyWorking$	0.002**	
	(0.001)	
$Minteg * PolicyNormative$		0.002**
		(0.001)
Industry FE/ Industry FE/Controls	YES	YES
Observations	2183	2183
Adjusted R-squared	0.382	0.380

Table 10: Hu Huanyong Line Demarcation Test

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	South	Hu Huan-yong Line	north	South	Hu Huan-yong Line	north
$PolicyWorking$	0.005*	0.010	0.006**			
	(0.003)	(0.009)	(0.002)			
$PolicyNormative$				0.004*	-0.000	0.002
				(0.003)	(0.003)	(0.001)
Industry FE/ Industry FE/Controls	YES	YES	YES	YES	YES	YES
Observations	0.337	0.488	0.800	0.324	0.442	0.650

Table 11: Heterogeneity analysis of key environmental protection cities

	(1)	(2)	(3)	(4)
VARIABLES	Key cities	Non-key cities	Key cities	Non-key cities
$PolicyWorking$	0.014**	0.002		
	(0.007)	(0.001)		
$PolicyNormativ$			0.007	0.001**
			(0.004)	(0.000)
Industry FE/ Industry FE/Controls	YES	YES	YES	YES
Observations	0.373	0.491	0.347	0.449

Table 12: Heterogeneity analysis of transportation hub cities

VARIABLES	(1) Transportation hub	(2) Non-transportation hub	(3) Transportation hub	(4) Non-transportation hub
$PolicyWorking$	0.030**	0.004*		
	(0.013)	(0.003)		
$PolicyNormativ$			0.001	0.004*
			(0.005)	(0.002)
Industry FE/ Industry FE/Controls	YES	YES	YES	YES
Observations	0.503	0.343	0.384	0.332

Table 13: Analysis of city size heterogeneity

	(1)	(2)	(3)	(4)
VARIABLES	Large cities	Non-large cities	Large cities	Non-large cities
$PolicyWorking$	0.021**	0.003		
	(0.009)	(0.003)		
$PolicyNormativ$			-0.008	0.005**
			(0.010)	(0.002)
Industry FE/ Industry FE/Controls	YES	YES	YES	YES
Observations	0.489	0.324	0.486	0.314

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