



Carbon Consequences of the Sharing Economy: Evidence from the Chinese Urban Context

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Abstract. This paper examines the environmental consequences of the sharing economy in the context of China's urban carbon reduction goals. Leveraging monthly panel data from 296 Chinese cities between 2015 and 2017, this paper employ a high-dimensional fixed effects (HDFE) model and treat the staggered Treat*Post of platform-based services as a quasi-natural experiment. Our findings reveal that the Treat*Post of sharing economy platforms significantly reduces urban carbon emissions, with an average decline of 0.61%. Robustness checks—including placebo simulations, alternative specifications, and subsample tests—confirm the reliability of the results. Mechanism analyses suggest that emission reductions occur through improved traffic efficiency and institutional synergy, particularly in cities with stronger governance capacity. Heterogeneity analyses further show that the carbon-reducing effects are more pronounced in economically developed and less industrialized (service-oriented) cities. These findings contribute to the understanding of how digital platforms interact with environmental outcomes and offer practical policy implications for fostering green innovation in urban governance.

Keywords: Sharing Economy, Platform Entry, Urban Carbon Emissions

1 Introduction

Against the backdrop of China's “dual carbon” strategy, cities—being the core of energy consumption and carbon emissions—urgently need to identify new pathways to achieve green and low-carbon development. The sharing economy (also referred to as the platform economy), characterized by efficient resource allocation, low marginal costs, and high utilization rates, provides potential solutions for urban carbon reduction [1,2]. In recent years, platform-based services such as ride-hailing, bike-sharing, and same-city delivery have expanded rapidly, leading to an intensifying debate on their environmental consequences, particularly their role in urban carbon emissions. This paper addresses this gap by empirically examining the impact of the sharing economy on urban carbon emissions using a large-scale panel dataset from Chinese cities. On one hand, the sharing economy promotes efficiency and may help reduce emissions; on the other hand, its penetration in transportation and logistics sectors

may induce rebound effects, possibly intensifying energy consumption and carbon emissions.

While research on the sharing economy's economic implications is growing, its environmental impact, particularly on urban carbon emissions, has been largely overlooked. Most existing literature has focused on economic outcomes such as employment, income distribution, and industrial transformation, while overlooking environmental effects. Studies that do consider environmental impacts often rely on theoretical reasoning or case-specific evidence and lack systematic identification based on large-scale panel data across multiple cities. Moreover, due to spatial heterogeneity in platform economy expansion, its carbon-reducing impact may vary across regions and urban characteristics. Hence, a more holistic and dynamic perspective is needed to assess whether the sharing economy truly reduces urban carbon emissions, and through what mechanisms and under what conditions.

Empirical evidence on the environmental impacts of sharing economies has been mixed. For instance, Li analyzed ride-splitting in Chengdu and find not all pooled rides reduce emissions [3], indicating location-specific heterogeneity. Similarly, Amantuni showed car-sharing yields 3–18% life-cycle CO₂ savings [4], but rebound effects can undermine benefits. In China, Zhang and Wang reported ride-hailing can increase public transit use in small-medium cities [5] but may still raise total emissions if private vehicle use is displaced [6,7].

In response, this paper employs a city-level panel dataset from China and utilizes a high-dimensional fixed effects (HDFE) model, treating the Treat*Post of platform economy as a quasi-natural experiment to identify the impact of the sharing economy on urban carbon emissions. This paper further explore the potential mechanisms through which platform Treat*Post affects emissions and conduct heterogeneity analysis across regional development levels and industrial structures. This study aims to provide empirical evidence and policy insights for promoting environmentally sustainable development of the sharing economy.

2 Theoretical Framework and Research Hypotheses

As a digital platform-based model facilitating the temporary allocation and multi-party.

Sharing of idle resources, the sharing economy may affect carbon emissions through several interrelated mechanisms. These include improvements in resource integration efficiency, shifts in transportation behaviors, and institutional substitution effects."From a business model perspective, sharing economy platforms reconfigure value propositions by monetizing idle assets (e.g., Uber's vehicle utilization), which inherently alters resource flow structures. This reconfiguration may create carbon leakage if platform-induced consumption offsets efficiency gains (e.g., low-cost ride-hailing stimulating discretionary travel)."

2.1 Resource Optimization and Efficiency Gains

The sharing economy reallocates underutilized assets (e.g., private cars, housing, labor) in a more efficient and flexible way than traditional models. With advantages in dynamic pricing, algorithmic matching, and real-time dispatching, platforms can reduce idle capacity and redundant supply. For example, ride-hailing services can promote carpooling and optimized routing, thereby cutting down unnecessary urban trips and potentially lowering overall carbon emissions [8]. Additionally, empirical evidence from China's urban delivery sector shows that digital platform entry can enhance green total factor productivity [9], further supporting the efficiency mechanism.

Sharing economy models align with circular economy principles, promoting sustainability by boosting utilization of idle assets [10,11]. Additionally, [6] highlighted how built environment and platform services together affect commuting emissions, a finding consistent with our transport-efficiency mechanism.

2.2 Dual Effects of Behavioral Responses and Modal Shifts

However, the environmental impact of platform-based services, particularly in transportation, may exhibit rebound effects. Due to lower transaction costs and convenience, platform services may induce new travel demand, especially in cities with weaker public transit systems. In such contexts, users may substitute low-carbon options (e.g., subways, buses) with platform-based alternatives, potentially increasing emissions if efficiency gains are insufficient to offset the added travel volume.

2.3 Institutional Substitution and Policy Synergy

The expansion of the sharing economy may also lead to institutional substitution. As platforms operate at scale, they often compel local governments to adjust regulatory frameworks (e.g., data supervision, eco-certification, congestion charges), encouraging more adaptive governance. Additionally, many platforms implement their own green initiatives—such as carbon credits and eco-friendly algorithm preferences—that may align with urban climate goals and magnify positive externalities.

Based on the above analysis, this paper propose the following hypotheses:

Hypothesis 1 (H1): The Treat*Post of platform economy services significantly reduces urban carbon emissions.

To further guard against confounding, this paper incorporate robustness suggestions from [7] and [12], who advocate for placebo simulations and alternative outcome variables in shared mobility studies.

Hypothesis 2 (H2): The emission-reduction effects of platform Treat*Post vary by regional development level and are more pronounced in economically developed areas.

Hypothesis 3 (H3): The emission-reduction effects of platform economy are more evident in cities with lower industrialization levels and higher proportions of the tertiary sector.

3 Empirical Strategy

3.1 Data Sources and Sample Construction

This study uses a balanced panel dataset at the city-month level, covering 296 Chinese cities from January 2015 to December 2017, totaling 10,656 observations. City-level carbon emissions are derived from the Center for Global Environmental Research, which aggregates $1\text{km} \times 1\text{km}$ gridded remote sensing data to calculate monthly CO_2 emissions (in tons) for each city. *Treat* and *Post* data are derived from City Statistical Yearbook and City Development Report. City-level socioeconomic data—including GDP, per capita income, industrial structure, government expenditure, and land area—are obtained from the China City Statistical Yearbook.

3.2 Variable Definitions

In this study, the dependent variable is the natural logarithm of monthly carbon emissions at the city level, denoted as $\ln(\text{CO}_2)$, which captures the intensity of urban carbon output over time. The core explanatory variable is the product of *Treat* and *Post*, in which *Treat* is a binary indicator which takes the value of 1 once a sharing economy platform enters a city and takes the value of 0 when a sharing economy platform doesn't enter the city. *Post* is a binary indicator which takes the value of 1 once the year is the year or after the year the sharing economy platform enters the city and takes the value of 0 once the year is before the year the sharing economy platform enters the city. This setup allows us to isolate the effect of platform economy $\text{Treat} \times \text{Post}$ on carbon emissions.

To mitigate potential confounding influences, this paper include a set of control variables that reflect key city-level characteristics. These include the natural logarithm of per capita GDP ($\ln(\text{GDP_per_capita})$), which proxies for the level of economic development, and the proportion of the secondary industry in GDP (*Industry_2*), capturing the degree of industrialization. Additionally, the share of the tertiary industry in GDP (*Industry_3*) reflects the structure of the service economy. This paper also control for the natural logarithm of a city's administrative land area ($\ln(\text{Land})$) and the ratio of public fiscal expenditure to GDP (*Govern_public*), which serves as a measure of government size. Besides, we also control for the fixed investment input of the city (\ln_INV) and the urbanization of the city (*URB*) to capture the construction level of the city and the population density of the city.

The empirical model adopts a high-dimensional fixed effects (HDFE) approach to account for unobserved heterogeneity. Specifically, we control for both city fixed effects and time fixed effects (including year and month, denoted by *ym*), thereby capturing city-invariant and time-specific shocks that may otherwise bias the estimates. To further explore heterogeneity in treatment effects, we interact the $\text{Treat} \times \text{Post}$ variable with key structural features, such as a binary indicator for developed versus less-developed regions ($\text{Treat} \times \text{Post} \times \text{Developed}$) and the level of industrialization ($\text{Treat} \times \text{Post} \times \text{Industry}_2$). These interaction terms enable us to investigate

how the impact of platform $Treat \cdot Post$ varies across different regional and economic contexts.

3.3 Model Specification

We estimate the following high-dimensional fixed-effects panel model:

$$\ln(CO2)_{it} = \beta_0 + \beta_1 Treat * Post_{it} + \lambda X'_{it} + u_i + \lambda_t + \varepsilon_{it} \tag{1}$$

In model (1), $\ln(CO_2)_{it}$ represents the natural logarithm of carbon dioxide emissions in city i at time t , capturing the intensity of urban carbon output. The key explanatory variable, $Treat$, is a binary indicator which takes the value of 1 once a sharing economy platform enters a city and takes the value of 0 when a sharing economy platform doesn't enter the city. $Post$ is a binary indicator which takes the value of 1 once the year is the year or after the year the sharing economy platform enters the city and takes the value of 0 once the year is before the year the sharing economy platform enters the city. The term X'_{it} denotes a vector of control variables, including economic, industrial, and geographic characteristics of the city. To account for unobserved heterogeneity, the model incorporates city fixed effects μ_i and time fixed effects λ_t , which control for time-invariant city-specific factors and temporal shocks common to all cities, respectively. Finally, ε_{it} is the random disturbance.

To ensure causal identification, all regressions employ city-clustered robust standard errors. We also include event-time interaction terms for parallel trend testing and conduct robustness checks via parallel trend test placebo tests and subsample heterogeneity analysis.

4 Empirical Results and Analysis

Table 1. Basic regression result

	LnCO2 (1)	LnCO2 (2)	LnCO2 (3)	LnCO2 (4)
<i>Treat * Post</i>	-0.0115*** (0.0028)	-0.0071*** (0.0027)	-0.0053** (0.0022)	-0.0063*** (0.0028)
$\ln(GDP_per_capita) \times 2016$	---	0.0051* (0.0024)	0.0114 (0.0072)	0.0098** (0.0040)
$\ln(GDP_per_capita) \times 2015$	---	0.0148*** (0.0028)	0.0056 (0.0032)	0.0312** (0.0123)
$Industry_2 \times 2016$	---	---	-0.0877 (0.0992)	0.0114 (0.0311)
$Industry_2 \times 2015$	---	---	0.0475* (0.0241)	0.0567 (0.0874)
$Industry_3 \times 2016$	---	---	-0.0224 (0.0754)	0.0638* (0.0317)
$Industry_3 \times 2015$	---	---	0.1084**	0.1075

			(0.0479)	(0.1121)
$\ln(\text{Land}) \times 2016$	---	---	-0.0014 (0.0011)	-0.0047*** (0.0012)
$\ln(\text{Land}) \times 2015$	---	---	-0.0056** (0.0022)	-0.0121*** (0.0033)
$\text{Govern_public} \times 2016$	---	---	---	0.0378** (0.0202)
$\text{Govern_public} \times 2015$	---	---	---	0.0654** (0.0301)
Constant	-2.0121*** (0.0002)	-2.0076*** (0.0187)	-1.2317*** (0.0287)	-1.7232*** (0.0321)
Other Control variables	Y	Y	Y	Y
City	Y	Y	Y	Y
Year	Y	Y	Y	Y
N	10656	10656	10656	10656
Adj R2	0.9993	0.9993	0.9993	0.9994

Fixed Effects: City (cityid) and Month (ym); Observations: 5,532; Clusters: 167 cities; Adjusted R²: 0.9992; Model: HDFE clustered at city level.

5 Robustness Checks

Building on the empirical model outlined in the previous section, we next conduct several robustness checks to confirm the reliability of our findings. These include placebo tests, subgroup robustness estimations, and alternative variable specifications.

5.1 Parallel Trend Test

To validate the identification assumption of the difference-in-differences (DID) strategy, this paper conducts an event study to examine the parallel trend assumption. Figure 1 presents the estimated coefficients and 95% confidence intervals for each period before and after the platform economy's Treat*Post. The vertical axis shows the estimated impact of platform Treat*Post on urban CO₂ emissions, while the horizontal axis represents the time relative to the Treat*Post event, with 0 indicating the month of Treat*Post.

As shown in figure 1, the estimated coefficients for the pre-treatment periods (event time -5 to -1) are close to zero and statistically insignificant, indicating that treated and control cities followed parallel trends in CO₂ emissions before the platform Treat*Post. In contrast, the post-Treat*Post coefficients become increasingly negative and several are statistically significant, suggesting a gradual and cumulative reduction in carbon emissions following platform Treat*Post. This pattern reflects the environmental benefits of platform economies through enhanced resource allocation and transport efficiency.

Overall, the results support the parallel trend assumption, and reinforce the credibility of the DID estimation strategy in identifying the causal effect of platform economy $Treat*Post$ on urban carbon emissions.

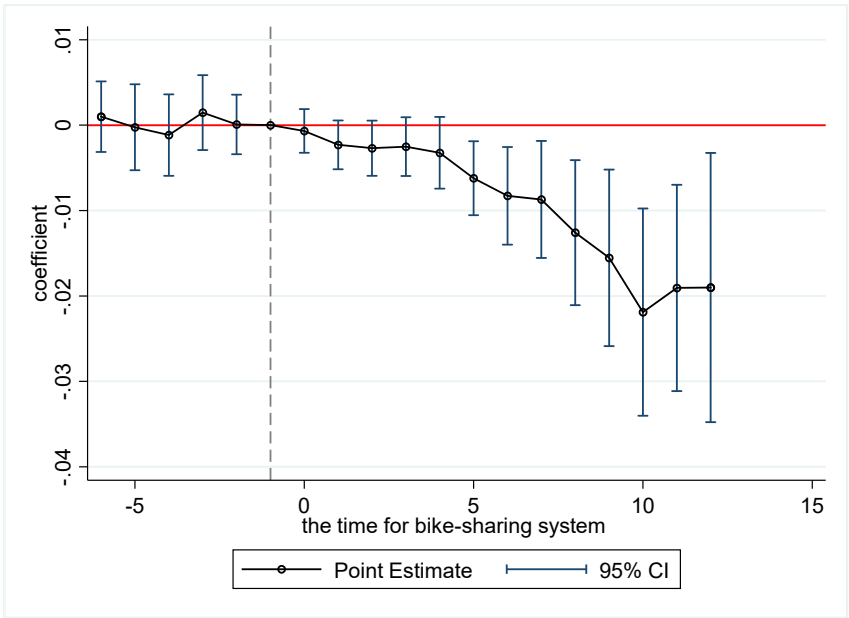


Fig. 1. Parallel Trend Test

5.2 Placebo Test

This paper randomly assign placebo treatment (fake $Treat*Post$) to untreated cities and re-estimate the model 500 times. As shown in Figure 2, the distribution of placebo estimates clusters around zero, while the actual $Treat*Post$ coefficient (-0.0063) lies significantly in the left tail. This suggests that the observed effect is unlikely to result from model misspecification or pre-existing trends, thus strengthening the causal interpretation.

To validate the causal interpretation, this paper conducts a placebo test by randomly assigning $Treat*Post$ timing to non-treated cities and re-estimating the model multiple times. In Figure 2, the actual $Treat*Post$ coefficient (-0.0063) lies significantly outside the distribution of placebo estimates, suggesting that the identified effect is unlikely to result from sample selection or pre-existing trends, thus reinforcing the robustness of our findings.

Table 1 presents the baseline estimation results using the HDFE model. The coefficient of the key explanatory variable $Treat*Post$ is -0.0063 , statistically significant at the 1% level. This indicates that the $Treat*Post$ of platform economy services is associated with a significant reduction in urban carbon emissions, averaging around 0.63%, thus supporting Hypothesis 1 (H1).

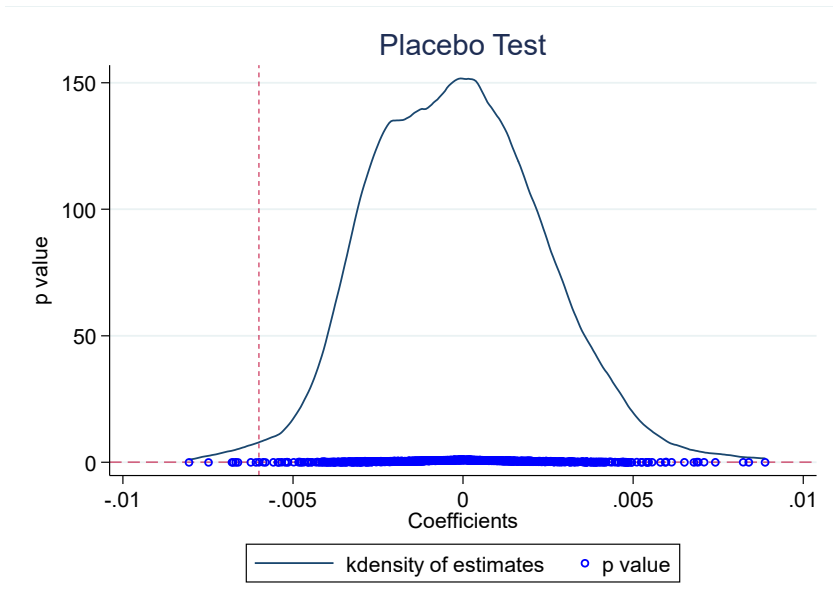


Fig. 2. Placebo Test

As for control variables: Higher per capita GDP ($\ln_GDP_per_capita$) is significantly positively correlated with emissions, reflecting increased energy demand in more developed cities; The proportion of secondary industry ($Industry_2$) positively affects carbon emissions, while the tertiary sector share ($Industry_3$) shows no significant effect; Land area and public budget expenditure (\ln_Land and $Govern_public$) exhibit partial significance via year-specific interactions.

These results imply that the sharing economy can generate environmental co-benefits through more efficient resource allocation, helping to mitigate urban emissions pressure.

5.3 Subsample Robustness

To account for potential structural differences across cities, this paper conduct robustness checks by re-estimating the baseline model on several refined subsamples. First, exclude direct-administered municipalities and mega-cities, which may exhibit distinct administrative and economic dynamics. Second, limit the sample to the year 2016, which marks the peak of platform expansion and may represent a critical period for evaluating environmental impacts. Third, remove border and non-mainland regions such as Hong Kong, Macau, and Taiwan to ensure comparability in institutional and geographic contexts. Across all of these subsamples, the estimated coefficients on the $Treat*Post$ variable remain negative and directionally consistent with the main results, with several estimates reaching statistical significance at the 5% level. These findings reinforce the robustness of our conclusions against sample selection concerns.

5.4 Alternative Specifications

To test the robustness of our findings, this paper re-estimate the baseline model using alternative measures of carbon emissions as the dependent variable. Specifically, this paper replace the logged total CO₂ emissions with three variants: the raw level of CO₂ emissions in tons, CO₂ emissions per unit of GDP, and CO₂ emissions per capita. Across all these alternative specifications, the estimated coefficients on the Treat*Post variable remain consistently negative and statistically significant. These results confirm that the observed emission-reducing effect of platform economy Treat*Post is not driven by a specific measurement choice, thereby reinforcing the reliability and robustness of our main conclusion. These findings are consistent with recent evidence from China's express delivery sector showing platform-based logistics can reduce emissions [13], as well as research on ride-hailing services and urban air quality in Shenzhen [14].

By employing placebo tests, subsample analysis, and alternative dependent variables, then verify that the observed negative relationship between the platform economy and urban carbon emissions is robust across multiple dimensions, ruling out concerns of model misspecification or sample bias.

6 Heterogeneity Analysis

Past studies suggest contextual factors shape sharing economy sustainability. For example, [5] noted ride-hailing's CO₂ benefits vary by urban transit infrastructure. Urban form [6] and digital platform governance [15] further moderate effectiveness.

To better understand the differentiated impacts of the platform economy on carbon emissions, this paper perform subgroup regressions based on two dimensions: regional development level and industrial structure (secondary sector share). This paper complement the empirical findings with theoretical reasoning to explain the observed heterogeneity.

6.1 Regional Development Level

In addition to the general effects, our heterogeneity analysis reveals that the sharing economy's impact varies across cities with different levels of economic development. Specifically, in economically advanced cities, the sharing economy benefits from more supportive institutions, better infrastructure, and higher user acceptance, which facilitate its growth. These conditions enable platforms to maximize their efficiency gains. Well-established public transit, digital infrastructure, and stronger environmental awareness further amplify the emission-reducing impact. Our results show that Treat*Post has a significantly negative coefficient of -0.0063 in developed regions, while it is insignificant in less developed areas. This highlights the critical synergy between platform capacity and local governance systems.

In economically advanced cities, where institutional capacity and infrastructure are typically stronger, the emission-reducing effects of the platform economy are more pronounced. Specifically, regression estimates show that in developed regions, the

coefficient for platform Treat*Post is -0.0063 and statistically significant, indicating a robust negative association between platform expansion and carbon emissions. In contrast, in less-developed regions, the coefficient is only 0.0013 and statistically insignificant, suggesting limited or no measurable effect. This pattern highlights that platform-driven environmental benefits are more effectively realized in regions with higher levels of economic development, thereby supporting Hypothesis 2 (H2).

6.2 Industrial Structure

Cities with lower shares of the secondary sector and higher shares of the tertiary sector tend to have carbon emissions stemming more from transportation and consumption-related activities[9,2]. These are precisely the sectors most directly impacted by platform-based resource reallocation. As such, platform Treat*Post has stronger marginal effects on emissions in these cities.

Empirical results confirm this pattern: in cities with a lower secondary industry share, Treat*Post has a significantly negative coefficient of -0.0125 ($p < 0.01$), whereas it is insignificant in high-industry cities. This suggests that the carbon-reduction benefits of the platform economy are more pronounced in service-oriented cities, reflecting a higher degree of compatibility between platform functions and urban industrial composition.

The heterogeneity analysis by industrial structure further confirms that the carbon-reduction benefits of platform Treat*Post are contingent on local economic composition. In cities with a higher share of the secondary industry (i.e., more industrialized), the coefficient on platform Treat*Post is -0.0024 and statistically insignificant, indicating no clear environmental impact. However, in cities where industrial activity is less dominant and the service sector plays a greater role, the coefficient is significantly negative at -0.0125 ($p < 0.01$). This suggests that platform-based efficiencies are better leveraged in service-oriented economies, aligning with Hypothesis 3 (H3) that anticipates stronger environmental gains in less industrialized urban contexts.

These heterogeneous effects highlight that the sharing economy delivers stronger environmental benefits in cities with stronger governance and more service-oriented economies. This underscores the need for place-based policy interventions to enhance institutional readiness, infrastructure, and regulatory frameworks that support both platform development and emission reduction.

7 Conclusion and Policy Implications

In conclusion, using monthly panel data for 296 Chinese cities from 2015 to 2017, this study exploits the staggered Treat*Post of platform economy services as a quasi-natural experiment and employs a high-dimensional fixed effects (HDFE) model to evaluate their impact on urban carbon emissions. This paper obtain the following main findings:

First, platform Treat*Post significantly reduces urban carbon emissions by an average of 0.63% , confirming the sharing economy's environmental co-benefits;

Second, such effects are more pronounced in economically developed and service-oriented cities, revealing marked heterogeneity;

Third, mechanism analysis identifies two key pathways: traffic efficiency improvement and governance co-evolution;

Finally, robustness checks—placebo tests, subsample analysis, and variable replacements—all validate the stability of the results. These findings corroborate earlier case studies on ride-hailing emissions [8] and platform-based logistics [13] in the Chinese context, while providing more systematic evidence across multiple cities and longer time horizons.

7.1 Policy Implications

Promote Greener Platform Operations.

Authorities should encourage platform enterprises to incorporate low-carbon elements into algorithms and operations, such as eco-friendly routing and carbon credit systems, to enhance environmental externalities.

Platforms: Develop carbon-accountable algorithms (e.g., Meituan's delivery route optimizer), Cost savings from reduced energy use + ESG premium.

Governments: Launch "Green Platform Certification" with tax incentives, Lower monitoring costs via platform self-regulation.

Investors: Integrate emission-reduction efficacy into ESG scoring, Mitigate regulatory stranded asset risks.

Enhance Policy Synergy in a Context-Specific Manner.

Pilot projects in cities with better governance and infrastructure should serve as models for integrating platform services with carbon governance in less developed areas.

Improve Data Governance and Regulatory Frameworks.

Encourage regulated data sharing from platforms to support carbon accounting, traffic optimization, and public service delivery.

7.2 Future Research

Limitations remain, such as imprecise measurement of platform intensity and limited access to granular mobility data. Future research may integrate high-frequency user or platform-level datasets to better capture the micro-level mechanisms through which the sharing economy affects emissions.

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