Research on the Impact Mechanism of Industrial Added Value on the Carbon Emission Rights Market

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Abstract. The carbon emission rights market is crucial in helping the country achieve its "dual carbon" goal. It's essential to assess how industrial added value impacts this market. This study focuses on China's carbon emission rights market, using a multi-period multiple difference model to test the influence of industrial added value empirically. The research reveals that industrial added value significantly enhances the development of China's carbon emission rights market and improves price discovery efficiency. Mechanism analysis demonstrates that industrial added value drives market development by linking industrial growth with corporate carbon emissions.

Keywords: Industrial added value, carbon emission rights market, impact mechanism

1   INTRODUCTION

Data as an independent factor of production has become increasingly important in enhancing economic and social efficiency, fostering sustainable development, and driving technological innovation[1-3]. As data analysis technology and application levels improve, the value contained in industrial-added data has garnered more attention[4]. Ample evidence [5-7] suggests that the announcement of industrial value-added data can stimulate the development of the carbon emission rights market. Consequently, this article focuses on the im-pact of releasing industrial value-added data on the carbon emission rights market.

The release of industrial value-added data can boost the development of the carbon emission rights market[8,9]. It is achieved in several ways: 1. By increasing the supply of data elements. 2. By optimizing the development environment and promoting the aggregation of innovative factors. 3. By leveraging the data multiplier effect. Data elements can link financial components, talent elements, technology elements, etc. It promotes the multiplier effect of data and facilitates the development of the carbon emission rights market[10].

However, in practice, the driving effect of industrial added-value data disclosure is not necessarily necessary. Moreover, previous research on the publication of industrial value-added data has focused more on the economic and social value[11,12]. Research

on the relationship between data publication and promotion has majored in normative theoretical analysis, with few scholars exploring the impact of industrial value-added data publication on the development of carbon emission rights markets from a micro perspective. Based on this, this article proposes and intends to answer the following questions: (1) Can industrial value-added data promote the carbon emission rights market? (2) What is the mechanism by which the release of industrial value-added data promotes the development of the carbon emission rights market? (3) Is there any heterogeneity in the impact of the release of industrial value-added data on the development of the carbon emission rights market? This article explores the impact of China's industrial value-added data on the carbon emission rights market and discusses its possible mechanisms of action.

2   RESEARCH DESIGN

2.1   Research Hypothesis

Compared to other production factors, data resources have the characteristics of reusability, shareability, and unlimited growth and supply, breaking the constraints of limited supply of scarce resources and surpassing the boundaries of traditional innovation theory. The value creation perspective holds that the publication of industrial added value data can enhance social supervision and trust in the government, improve government governance transparency, and improve the resource allocation efficiency of the carbon emission rights market. In summary, the data elements released by the publication of industrial value-added data are widely applied in the carbon emission rights market, and help promote the aggregation of other innovative factors and improve the supply of innovative resources for enterprises. Therefore, the release of industrial value added data can have a significant impact on the carbon emission rights market.

It is worth noting that the release of industrial value-added data has promoted the prosperity of data processing activities such as data collection, storage, analysis, and application, which helps to encourage the development of the carbon emission rights market.This article believes that the announcement of industrial value-added data can provide innovative components, leverage the linkage effect of data elements on other elements, and further promote the development of the carbon emission rights market. Based on the above analysis, the release of industrial value-added data may have a positive impact on the development of the carbon emission rights market. Based on the above analysis, the growth of industrial added value may have a positive impact on the development of the carbon emission rights market. So, the hypothesis is as follows:

H1: The industrial added value has a positive impact on the development of the carbon emission rights market.

2.2   Research Method

Sample Selecting and Data Source. This article selects carbon emission rights from July 2021 to May 2024 as the initial research sample and excludes samples with

missing data. The carbon emission rights data used in the article comes from the Shanghai Environment and Energy Exchange, the industrial added value data comes from the National Bureau of Statistics, and the control variable data comes from the China Economic Net statistical database. This article has truncated all continuous variables at the top and bottom 1% level.

The Model. This article studies the impact of industrial-added value on the market price of carbon emission rights. The empirical model is as follows:

$$cp_{i,t} = \alpha + \beta_0 Iav_{i,t} + \sum_{i=1}^{n} \beta_i Cv_{i,t-1} + YFE + \varepsilon_{i,t} \tag{1}$$

where $cp_{i,t}$ are the carbon emission rights price of the city i at time t. IaV is the industrial added value. Cv are the control variables. YFE is the year fixed effect. ε is the estimation error.

The coefficient β reflects the changes in carbon emission rights market prices between the experimental group and the control group before and after the release data of industrial added value to test H1. To control the unobservable individual heterogeneity, the model controls variables and time-fixed effects and is adjusted for heteroscedasticity and company-level clustering.

The Adaptability Test of the Model. The premise of using a multi-period difference model is to comply with the parallel trend assumption. That is, the changing trend of variables in the treatment group and the control group is similar. Therefore, if the parallel trend assumption holds, the effect of industrial added value should appear after the data is announced.

2.3   The Definition of the Variables

(1) The Explained Variable
This article mainly uses the growth rate of carbon emission market prices to measure the development level of the carbon emission market. Considering the time lag issue, the growth rates of the current period and the future one period are used to measure the development level of the carbon emission market. Since the dependent variable is from the future one period, the actual regression sample period is from 2021 to 2023.
    (2) The Explanatory Variable
    This article mainly uses the announcement of industrial-added value as the mostly explanatory variable. If the industrial added value has already been announced at time t, the value is 1. Otherwise, it is 0. Its essence is Treat * Post, where Treat=1 indicates that a special day belongs to the day of industrial value-added data release, and Post=1 suggests that the sample is in the year of industrial value-added data release or later.
    (3) Control Variable

Drawing on existing literature, Model (1) controls for variables related to carbon emissions at both the company and city levels, including R&D investment (RD), company size (Size), company age (Age), financial leverage (Le), and the proportion of the secondary industry (SCR). This article uses lagged measures for all control variables. The detailed definitions of specific variables are shown in Table 1.

Table 1. The definition of control variables

Variable name	Definition of the variables
RD	R&D variable, measured by the ratio of R&D to operating revenue
Size	The company size, measured by taking the logarithm on the total asset added 1
Age	The company age, measured by taking the logarithm on the company listing age
Le	The financial leverage of a company, measured by the ratio of total liabilities to total assets
SCR	The proportion of the secondary industry in the GDP

3   EMPIRICAL ANALYSIS

3.1   Descriptive Statistics

The mean value of the dependent variable carbon emission price growth rate is 0.0025 and shows an increasing trend over time, which is consistent with the reality that there is a certain time lag in the release of industrial added value data, and the mean difference test results show significant differences between the dependent variable groups. The main explanatory variable in this article is the announcement of industrial added value data, with a mean of 0.0048, while other control variables generally follow a normal distribution.

3.2   Regression Results and Analysis

This article conducts stepwise regression on the technique of the multi-period difference model, and Table 2 reports the regression results between the publication of industrial value-added data and the market price of carbon emission rights. The coefficients in columns (1) and (2) are significantly positive, indicating that the publication of industrial value-added data has promoted the growth of carbon emission market prices. After adding control variables, the direction and significance of the coefficients in column (3) have not changed, indicating that the conclusion is robust and supported by empirical evidence. In columns (4) to (6), the coefficient remains significantly positive when using the growth of carbon emissions from the first to third periods of the future as the explained quantity, indicating that the release of industrial value-added data has a long-term driving effect on the carbon emissions market. It is mainly due to the growth of industrial value-added data indicating that industrial development is improving, energy consumption is increasing, and corporate carbon emissions are rising, increasing carbon emissions market prices.

Table 2. Regression Results

Variables	(1) CER_t	(2) CER_t	(3) CER_t	(4) CER_{t+1}	(5) CER_{t+2}	(6) CER_{t+3}
IaV	0.5869***	0.0401*	0.0626**	0.0785***	0.0783***	0.0581**
	(28.844)	(1.985)	(2.246)	(2.741)	(2.738)	(1.998)
RD			6.8845***	6.7432***	6.1223***	5.1208***
			(11.782)	(12.014)	(11.962)	(10.981)
Size			0.2658***	0.2884***	0.2856***	0.2664***
			(11.754)	(12.745)	(12.858)	(12.130)
Age			0.1136***	0.0897***	0.0523***	0.0235***
			(4.283)	(3.269)	(1.956)	(0.841)
Le			-0.0584	-0.0912	-0.0903	-0.1021
			(-0.830)	(-1.298)	(-1.408)	(-1.510_
SCR			0.1230	0.2468	0.3851	0.4673
			(0.501)	(1.010)	(1.605)	(1.935)
Year/Company	no control	control	control	control	control	control
intercept	3.5225	0.0214	-6.2461***	-6.3014***	-6.3897***	-6.0221***
N	675	675	675	675	675	675
Adj R²	0.680	0.147	0.251	0.223	0.208	0.194

Note: *, **, ***denote significance at the 10%, 5%, and 1% levels (two tailed test), respectively

3.3 Mechanism Analysis

The core of industrial added value data release is to increase the provision of data elements in the economic environment, which can be linked and coordinated with environmental protection elements, carbon emission elements, etc., to exert the linkage effect of data elements on other elements, improve the comprehensive allocation efficiency of resources, and promote the development of the carbon emission market. Moreover, the release of industrial added value data will further motivate enterprises to develop and grow around data, accelerate their carbon emission transformation, and further promote the development of the carbon emission rights market. In summary, the release of industrial value-added data helps integrate data elements and traditional elements, promote the transformation and upgrading of corporate carbon emissions, and thus promote the development of the carbon emission rights market.

This article examines the impact mechanism of corporate carbon emission transformation, using textual methods to measure the degree of corporate carbon emissions. The regression results in Table 3 show that the release of industrial value-added data significantly promotes the transformation of corporate carbon emissions and improves corporate technological capabilities. The degree of corporate carbon emissions has a significant positive impact on the carbon emissions market. It plays a mediating role partially between the release of industrial value-added data and the carbon emissions market.

Table 3. Industrial added value and carbon emission

Variables	(1) $Capx$	(2) CER_t	(4) CER_{t+1}	(5) CER_{t+2}	(6) CER_{t+3}
IaV	0.0025**	0.0526***	0.0594***	0.0583***	0.0426**
	(2.256)	(2.986)	(3.361)	(3.187)	(2.387)
$Capx$		0.0321	0.1682*	0.3567***	0.4285***
		(0.286)	(1.805)	(3.010)	(3.781)
Control Variable	control	control	control	control	control
Year/Company	control	control	control	control	control
intercept	0.0469	-5.7564***	-5.8994***	-5.5982***	-5.0869***
	(1.046)	(-11.203)	(-11.226)	(-10.621)	(-9.512)
N	675	675	675	675	675
$Adj\ R^2$	0.501	0.162	0.230	0.184	0.163

Note: *, **, ***denote significance at the 10%, 5%, and 1% levels (two tailed test), respectively

3.4   Heterogeneity Test

The release of industrial value-added data has increased the supply of data elements. Better analysis, mining, and utilization of this data may have a more significant promoting effect on the carbon emission rights market. This article uses information technology asset investment (IT) to measure the data processing capability of the market. It incorporates its interaction term with the industrial value-added data variable (IaV_IT) into the regression. The regression results reported in Table 4 indicate that when there is a significant investment in information technology, the promotion effect of the carbon emission rights market through the publication of industrial value-added data is more important.

3.5   Robust Test

The article included a regional characteristic variable, regional fiscal revenue, in the robustness test to account for the potential impact of regional economic levels on carbon emissions. Additionally, the study attempted to enhance fixed effects at the urban level and focused the research sample specifically on the power industry. Following these robustness tests, the study confirmed that the main conclusion remains valid.

Table 4. Heterogeneity test results of industrial added value data announcement levels

Variables	(3) CER_t	(4) CER_{t+1}	(5) CER_{t+2}	(6) CER_{t+3}
IaV_IT	3.1050***	3.0568***	2.6574***	2.9510***
	(5.426)	(6.235)	(5.387)	(7.236)
IaV	0.048	0.0653**	0.0581**	0.0426

	(1.613)	(2.014)	(2.085)	(1.431)
IT	0.6523	0.5102	0.3045	-0.1621
	(0.931)	(0.839)	(0.509)	(-0.213)
Control Variable	control	control	control	control
Year/Company	control	control	control	control
intercept	-7.8016***	-6.3014***	-6.3897***	-6.0221***
	(-6.302)	(-6.401)	(-6.124)	(-5.456)
N	675	675	675	675
Adj R²	0.307	0.299	0.272	0.237

Note: *, **, ***denote significance at the 10%, 5%, and 1% levels (two tailed test), respectively

4   RESEARCH CONCLUSIONS AND POLICY RECOMMENDATIONS

4.1   Research Conclusions

This article explores the impact of announcing industrial added value data on China's carbon emission rights market. It looks at how this data affects market prices and improves market efficiency. The article considers macroeconomic elements and the micro perspective of industrial added value data announcement to understand their roles in the carbon emission rights market. The empirical research has found that

(1) The release of industrial-added value data helps to improve the efficiency of the carbon emission rights market, and it has a positive effect on the development of the carbon emission rights market.

(2) The promotion effect of industrial added value disclosure is achieved through data elements and capital elements. This discovery provides a useful exploration of the micro pathways through which the publication of industrial added value promotes the development of the carbon emission rights market, revealing the underlying mechanisms by which the publication of industrial value-added data affects the development of the carbon emission rights market. It helps to enrich and expand the relevant research on the influencing factors of the carbon emission rights market.

4.2   Policy Recommendations

The research in this article provides valuable insights for better managing industrial value-added data and promoting the development of the carbon emission rights market. The following policy recommendations are proposed:

(1) Establish a mechanism for publishing industrial value-added data and improve the quantity and quality of data openness. Conduct multi-dimensional and multi-level evaluations based on the quantity, quality, and availability of data disclosure to enhance the quality of industrial value-added data and achieve interconnectivity between different government databases.

(2) Strengthen the management of industrial value-added data disclosure, improve the regulatory system for data openness, and enhance the management level of data openness platforms.

FUNDING

REFERENCES

1. Zhang S, Wu K, Zhang R, et al. Data empowerment: Technological innovation effects of government data opening[J]. Journal of Intelligence, 2021, 40(7): 127-133.
2. Li H. Exploration of the development of carbon emission trading under the dual carbon goal[J]. Business Observation. 2024, 10(20):73-76.
3. Li L, Wu S, Tian Y. Carbon emission trading and corporate green technology innovation[J]. Journal of statistics and information. 2024,39(6): 89-99.
4. Wang K, Su X, Wang S. How does the energy-consuming rights trading policy affect China's carbon emission intensity?[J]. Energy, 2023, 276:127579.
5. Liu Y, Sun H, Meng B, et al. How to purchase carbon emission right optimally for energy-consuming enterprises?Analysis based on optimal stop model[J]. Energy Economics, 2023,124:106758.
6. Zhou D, Lu Z, Yuan Q. Do carbon emission trading schemes enhance enterprise green innovation efficiency? Evidence from China's listed firms[J]. Journal of Cleaner Production, 2023,414:137668.
7. Chen M, Wang K. The combining and cooperative effects of carbon price and technological innovation on carbon emission reduction: evidence from China's industrial enterprises[J]. Journal of Environmental Management,2023,343:118188.
8. Perdichizzi S, Buchetti B, Cicchiello A F, et al. Carbon emission and firm's value: Evidence from Europe[J]. Energy Economics, 2024,131:107324.
9. Geng W, Liu X, Liao X. Mechanism analysis of the influence of intelligent manufacturing on carbon emission intensity:Evidence from cross country and industry[J]. Environment, Development and Sustainability, 2024,26(6):15777-15801.
10. Li Y, Yang X, Du E, et al. A review on carbon emission accounting approaches for the electricity power industry[J]. Applied Energy, 2024,359:122681.
11. Hu S, Yuan Z, Wang A. Improving carbon emission efficiency in Chinese manufacturing: A study considering technological heterogeneity and noise[J]. Energy, 2024,291:130392.
12. Martinsson G, Sajtos L, Stromberg P, et al. The effect of carbon pricing on firm emissions: Evidence from the swedish co2 tax[J]. The Review of Financial Studies, 2024, 37(6):1848-1886.