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Original Paper

Analysis of the Performance and Influencing Factors of China's Carbon Market in 2022

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Abstract

China's carbon market is pivotal in the global battle against climate change, especially as the world's largest emitter of greenhouse gases. The establishment and effective management of this market are critical for advancing global environmental sustainability. Central to this effort is the carbon trade price (CTP), widely recognized as a key indicator of market fluctuations. In 2022, China's carbon market experienced significant turmoil, contrasting sharply with the resilience of the European carbon market, which demonstrated steady demand and price growth. This article reviews existing literature on the factors influencing CTP, identifying crucial elements such as environmental conditions, policy frameworks, market dynamics, and economic indicators that shape China's Emissions Trading System (ETS). A detailed analysis of these factors for the years 2021 and 2022 is provided. Additionally, I propose further factors that may impact the CTP and offer a series of policy recommendations aimed at enhancing the effectiveness and stability of China's carbon market.

Keywords

carbon market, carbon trade price(CTP), influencing factor

1. Introduction

In a world increasingly concerned about climate change and its environmental impacts, carbon trading mechanisms have emerged as crucial tools in the global effort to reduce greenhouse gas emissions. Currently, there are 21 carbon emission trading systems operating globally. Since 2013, China has spearheaded the implementation of carbon trading in seven provinces and cities, including Beijing and Shanghai. The effectiveness of the carbon market has a crucial impact on achieving China’s emission reduction commitments, reducing emission and associated costs, enhancing China’s position in the global carbon market, and its voice in international climate change discussions.

After a decade of preparation, China’s national ETS went online in July 2021, with the world’s largest

of its kind in terms of emissions regulated, covering companies that together emit three times more than those covered by the European Union's ETS. In 2021, a total of 412 million tons of emissions allowances had changed hands on the market and the cumulative turnover had reached 1289 millions of euros. Both figures are dwarfed by those of the EU ETS, which has been running for nearly 20 years. By 2022, the Chinese ETS saw a substantial decline, with trading volume plummeting by 89% to 85 million tons. Similarly, the trading value decreased by 61% to 504 million euros. Meanwhile, even though trading volume of EU ETS also dropped from 12214 million tons to 9277 million tons, the trading value increased by 10%. Trading value or carbon trade price (CTP) can be deemed as the most crucial indicator to show the fluctuations of carbon market (Yan, Maria, Luyue, Yoko, Lisa, & Tatiana, 2023)

This article commences with a review of the literature concerning the factors that influence the CTP. This is followed by an analysis of these factors in the years 2021 and 2022. Finally, we propose additional factors that may impact the CTP and offer policy recommendations.

2. Literature Review

Current research on the CTP center around topics such as (1) Externality theory and emission trading theory which is the theoretical basis of carbon trading market (2) Mechanism of the carbon market. (3) The influencing factors of the CTP, which can be affected by market trading, policies, and the development of the economy.

2.1 Theoretical Rationales for Carbon Trading

2.1.1 Externality Theory

In economics, an externality is an indirect cost or benefit to an unrelated third party resulting from the activities of another party. Externalities can be considered as unpriced components of market transactions for consumers or producers. Greenhouse gases, such a carbon dioxide produced by corporate production activities, are the main cause of global warming. In economics, this is a typical external diseconomy. The carbon trading market trades carbon emission allowances as commodities and clarifies the carbon allowance emission targets of each enterprise. Enterprises can exchange quotas in the carbon trading market according to their own needs, realizing the effective allocation of resources in the carbon trading market and solving the problem of externalities. Shi et al. (2018) pointed out that carbon emissions trading, as an emission reduction mechanism centered on property rights theory and market trading methods, plays a crucial role in achieving low-carbon economic development and has been widely recognized worldwide (Shi, Zhang, Zhou, & Yang, 2018).

2.1.2 Emission Trading Theory

Emissions trading is a market-based approach to controlling pollution that reduce the emissions of pollutants by providing economic incentives. The concept is also known as emissions trading scheme (ETS) or cap and trade (CAT). It is wildly use in many schemes, such as the carbon emission trading for CO2 as a prominent example and other greenhouse gases including pollutants like sulfur dioxide

which is a tool for climate change mitigation.

In an emissions trading scheme, a central authority or government agency allocates or sells a certain number ("cap") of permits that allow a specific amount of a particular pollutant to be emitted for a specified period of time. Polluters who want to increase their emissions must buy permits from other polluters who are willing to sell them. According to Coase theorem, if the transaction cost is zero, as long as the initial definition of the property rights is clear and the parties to economic activities are able to negotiate the transactions, the result of market equilibrium will lead to the efficient allocation of resources (Zhao, 2004).

2.2 Mechanisms

2.2.1 Mechanism of the Carbon Market

CTP depends on the balance of supply and demand for carbon allowances in the market. The balance between supply and demand of carbon emission allowances in the market. CTP refers to the mechanism that influences the actual supply of total carbon emissions through allowances, auctions, and agreement transfers. It restricts market participants through default penalties and determines the price gap between carbon emissions in the primary and secondary markets, which in turn affects the actual total demand for carbon emission allowances.

In China, studies have shown that the total number of allowances in the carbon emissions trading scheme affects the CTP. Addressing the issues related to the overall carbon emission control and the pricing function of carbon emission rights, Chen et al., examined the necessary institutional arrangements for low-cost carbon pricing and active market participation, such as the overall control system, the quota allocation system, the verification system and the effective trading system (Chen, Huang, & Bin, 2021). Peng and Zhong explored the logic of carbon price formation, arguing that through the emission control thresholds, the discovery of carbon allowances to be included in the system Wu and Zhang discuss that the auction volume and negotiated transfer volume of carbon emission rights will have an impact on the carbon price in the secondary market in the case of refundable allocation, and the penalty for non-compliance will directly stimulate the demand for carbon emission rights in the market, which in turn will affect the price in the secondary carbon market (Wu, & Zhang, 2021). Fan and Wang further argue that the design of China's carbon trading mechanism requires adequate sectoral coverage due to the large differences in regional economic development (Fan, & Wang, 2014). Zhang et al., point out that all pilot markets directly or indirectly cover energy-intensive, high-pollution and high-emission sectors, which provides a common basis for determining the CPT, but also produces different impacts (Zhang, Zhang, &Yu, 2021)

2.2.2 Carbon Financial Mechanisms

The Carbon Financial Mechanism (CFM) employs the price prediction function of carbon financial derivatives to form CTPs. With regard to China, the study concurs with the ineffective application of the carbon financial mechanism. This is considered to be one of the important reasons for the low carbon price in China's pilot markets (Ji, Hu, Tang, & Qu, 2021). Zhu et al., found that carbon financial

derivatives are more abundant when the gap between the carbon price and the marginal abatement cost (MAC) of carbon dioxide is small (Zhu, Long, & Gong, 2022). Liu C et al. found that there Empirical evidence indicates a significant relationship between the average price of carbon credits in the six pilot markets in China and the total amount of carbon emissions in the region, as demonstrated by a regression test (Liu, Zhang, & Zhou, 2022). However, the relationship between green bond issuance and carbon emission right trading volume was not found to be significant, suggesting that this relationship may be inconsequential (Liu, Luan, & Guo, 2022). It is commonly accepted that as China's financial market continues to develop, the role of carbon financial mechanisms in stimulating the trading volume of carbon emission rights will become increasingly significant.

2.2.3 Carbon Tax Mechanism

The carbon tax mechanism is a policy instrument employed by the government to regulate the carbon content of fossil fuels for greenhouse gas emissions. It is a form of taxation that restricts the carbon emissions of enterprises. A number of studies have focused on the differences and correlations between the two pricing mechanisms of carbon tax and carbon trading, with particular attention paid to the three dimensions of carbon price fluctuation, transaction cost, and emission reduction effects. In comparison, the carbon emission rights market is more elastic on the supply side and exhibits lower price fluctuations in response to demand shocks. Jiang posited that the government exerts direct influence on fuel prices through taxation, thereby affecting demand and guiding the formation of market carbon prices through price intervention. Liu L. et al. posited that the carbon tax mechanism fixes the price of carbon emissions through the setting of tax rates, despite the inherent uncertainty in reducing carbon emissions. It is therefore thought that the government’s ability to control taxation represents an important avenue for stabilising the CTP should China adopt this practice.

2.3 Factors Influencing CTP

The mechanisms of CTP formation analyzed above suggest that CTP may be influenced by market transactions, policies and economic developments.

Some literature has explored the factors that influence CTP. Scholars have primarily focused on the EU carbon emissions trading system as a subject of study, investigating the driving and determining factors related to the carbon price. Dutta (2019) analyses the data of the EU emissions trading mechanism and suggests that, following the offset of voluntary emission reductions and forestry carbon sinks obtained by emission-control enterprises against their own emissions, the remaining part will be traded in the secondary market (Dutta, 2019). Wang (2021) analysed the formation of the carbon financial mechanism in Western developed countries, noting that the United States had implemented the carbon financial trading mechanism with great alacrity following the introduction of the Kyoto Protocol. This had enabled the country to effectively predict the price fluctuations in the carbon trading market through the trading volume of carbon financial futures, thereby promoting the stability of the carbon resource market (Wang, 2021). Furthermore, empirical evidence indicates that the futures price of the EU carbon market is an effective predictor and mitigator of carbon price risk (Wu & Zhang, 2021).

The development of China's carbon market pilot region has been relatively recent and nascent. The majority of Chinese scholars have focused their attention on single or multiple carbon pilot cities with active carbon trading. In order to identify the main factors affecting the carbon trading pilot programme (CTP) in the eight pilot regions in China, regional spatial disparities, the level of industrial development, the degree of development of low-carbon industries and the degree of atmospheric pollution, as well as the maturity of green technologies, have been considered. In selecting the factors to be considered, both macroeconomic factors and energy price factors were identified as particularly relevant. In terms of the impact of these factors, the impact of energy prices, weather changes, and policy measures were found to vary significantly (Ji & Hu, 2018)). In light of regional spatial disparities, the stage of industrial development, the degree of development of low-carbon industries, the degree of atmospheric pollution, and the maturity of green technologies, it can be posited that these factors exert a significant influence on CTP in the eight pilot regions of China (Song, Zhang, Ge, Huang, Huang, & Xiong, 2022). In the selection of influencing factors, macroeconomic and energy price factors are more widely recognised.

Based on the CTP formation mechanisms previously outlined and relevant literature on the subject, we can identify and generalise the influencing factors of CTP. These factors can be categorised into four distinct groups: macroeconomic factors, policy factors, energy price factors and environmental factors.

3. Carbon Market Performance

3.1 Global Carbon Market in 2022

Sustained elevated carbon prices, particularly within the European ETS, resulted in a record-breaking total global carbon market turnover in 2022, despite an overall decline in traded volume of 21 percent in comparison to 2021. Despite the relatively low volume of transactions, with just over 12.5 billion tonnes of carbon traded globally in 2022 (equivalent to 12.5 gigatonnes of CO2), higher prices per unit led to an increase in the value of the carbon markets. This was particularly evident in the large, well-established emission trading systems (ETS) in Europe and North America. Refinitiv estimates that the value of these transactions was approximately €865 billion, representing an increase from €762 billion in 2021 (Yan, Maria, Luyue, Yoko, Lisa, & Tatiana, 2023).

The European Union Emissions Trading System (EU ETS) provides the most illustrative example of a sustained upward trajectory in the cost of carbon. The North American carbon market, which encompasses the Regional Greenhouse Gas Initiative (RGGI) in the Northeast and the Western Climate Initiative (WCI), which includes California among its member states, offers an equally compelling case. Additionally, the Western Climate Initiative (WCI), which encompasses California, and the Northeast Regional Greenhouse Gas Initiative (RGGI), also known as RGGI, in the United States, along with New Zealand's carbon emissions trading scheme, warrant mention. Additionally, the New Zealand Emissions Trading Scheme merits consideration. The countries and regions in which these carbon markets are located are pursuing increasingly aggressive climate objectives, with emissions trading

poised to assume a pivotal role in achieving these goals. As was observed last year, the sustained price escalation can be attributed to this elevated climate policy ambition. This enhanced climate policy ambition reflects market participants' anticipations of future supply-demand imbalances. Market participants' expectations of a constrained supply/demand equilibrium in the future.

By 2022, the global impact of the Covid-19 has become prominent. The decline in productivity and production output due to the disruption of the international supply chain was particularly pronounced in 2022, leading to an overall decline in the global carbon trade of twenty-one percent in 2022. An economic slowdown and a surge in demand due to an epidemic have increased inflation, while hampered productivity due to supply chain interruptions has led to corporate layoffs and labor shortages.

3.2 China Carbon Market in 2022

With the first compliance period having ended and a new allocation plan (for the second compliance period) not even drawn up, the domestic ETS will enter a period of relative inactivity from 2022 onwards. A total of 51 million China ETS allowances will change hands during 2022: 6 million will be "listed and traded" on exchanges, and 45 million will be traded off-exchange. Even though trading only took place for six months in 2021 instead of a full year, this represents a 70% reduction in trading volume compared to 2021. The weighted average 2022 CEA is 55.30 USD/t (approx. 8.4 dollar/t), almost 30 % up on the weighted average 2021 CEA. The closing price of the quota on the last trading day of the year was $55 per metric ton (about $8 per metric ton), which is 1.4% higher than the price on the last trading day of 2021. Based on the average price and total volume of all types of trades, the annual turnover of listed trades is about RMB358m (about €49m), the annual turnover of bilateral (OTC) trades is about RMB2456m (about €336m), and the total value of NETS is about €385m. This is down 62% from last year, when the total value of CEA transactions exceeded €1 billion.

Table 1. China ETS and EU ETS Performance in 2022 (Yan, Maria, Luyue, Yoko, Lisa, & Tatiana, 2023)

Area	Volume (Mt)	Value (€ million)	Volume Change	Value Change
China	85	504	-79%	-61%
EU ETS	9,277	751,459	-24%	10%

The total number of trading days will be 242, i.e. 50 weeks from 4 January to 30 December. In January, trading volumes and prices spiked as companies that had not yet completed the first phase of compliance scrambled to trade CEA. This activity contributed to the highest price for CEAs since the inception of the program - RMB 61.38 per metric ton (approximately 8.4 dollar) - on January 28.

From February through October, little market movement was seen as Chinese policymakers focused on pandemic and other priorities, leaving covered companies to grapple with regulatory decisions (such as

subsidy distribution) that could clarify their compliance requirements.1 CEA trading volume increased during this period as a result of the Department of Energy and Environment's (DOE) publication of its draft allocation plan. Over 40% of the trading days saw CEAs trading below 100. The higher trading volume can be attributed to the announcement of the draft plan on the 3rd of November. The approach of the 2023 Lunar New Year, however, put a damper on the end-of-year rally, as firms started selling CEAs to gain more flexible cash flows to optimize their financial position and prepare for staff bonuses.

4. Factor Analysis

This section explores the potential factors driving the decline in the both trade volume and price during Covid outbreak.

4.1 Environmental Factors

The influence of environmental factors on CTP has been a topic of debate among scholars. Some argue that the environment plays a role, while others maintain that it does not. The temperature of the atmosphere and pollution levels can directly influence energy consumption or give rise to regulatory policies that restrict work and production, which in turn affects the demand for carbon credits and CTPs. (Song, Zhang, Ge, Huang, Huang, & Xiong, 2022) Bredin and Muckley (2011) employ Johansen's multivariate covariance likelihood ratio test to examine the impact of climate and environmental factors on the anticipated cost of CO_2 emission permits in the United States over the course of 2005-2009. The findings demonstrate that a rise in the air quality index is associated with a rise in carbon emissions allowances, while temperatures that are both exceptionally high and low exert a modest influence on carbon pricing (Don & Cal, 2011). Additionally, the study of CTP in China yielded divergent outcomes regarding environmental factors. Jiang and Wu (2007) selected three carbon trading pilots, situated in Beijing, Shanghai and Hubei, respectively, with the intention of evaluating the influence of meteorological alterations on carbon prices. The findings demonstrate that meteorological fluctuations are significantly associated with carbon trading prices (CPT) (Jiang & Wu, 2007). In order to ascertain the relationship between weather conditions and carbon prices, Li employed a cointegration analysis on the data from Beijing and Shanghai between 2018 and 2019. The analysis revealed that air quality has shrinked carbon prices, while abnormal weather has no discernible effect on the latter. The outcome of this analysis indicates that the implementation of emission reduction policies is not as effective as it could be, given the specific geographical conditions.

In 2022, environmental factors played a significant role in impacting China's carbon market. The year saw a complex interplay of natural and anthropogenic influences that affected the dynamics of carbon trading. Extreme weather events, such as severe floods and droughts, disrupted industrial operations and energy production, leading to fluctuations in emissions levels. For instance, severe droughts in southwestern China reduced hydropower generation, causing a temporary increase in coal-fired electricity production, which in turn affected emissions data.

Additionally, the ongoing COVID-19 pandemic continued to influence environmental factors by altering industrial activity patterns and energy consumption. The intermittent lockdowns and reduced economic activity led to a temporary decrease in emissions, creating an oversupply of carbon credits in the market. This oversupply, coupled with uncertainties about the effectiveness of emissions reduction initiatives, contributed to volatility in carbon credit prices and undermined the stability of the carbon trading system. The environmental disruptions in 2022 thus highlighted the sensitivity of the carbon market to both climatic and operational changes, raising concerns about its resilience and long-term efficacy in driving sustainable environmental practices.

4.2 Macroeconomic Factors

The level of macroeconomic development constitutes a fundamental basis for the CTP. This in turn exerts an influence on the changes that occur in the CTP. The macroeconomic activities that take place affect the way in which emission control enterprises function, as well as the supply and demand within the carbon market. Furthermore, fluctuations in the CTP are caused by fluctuations in macroeconomic factors. In China, there appears to be a negative correlation between macroeconomic factors and the changes that occur in the CTP. Wang and Hu employed the EEMD method to decompose the CTP and the intrinsic mode function, analysing the influence of internal market mechanisms and external market environments (Wang & Hu, 2018). The results demonstrated a significant negative correlation between the GDP growth rate of each region and the The CTP was analysed by Chu et al. in order to determine the influence of macroeconomic factors on the carbon prices of different quartiles. The results indicated that macroeconomic factors do indeed influence the price changes, with the medium prices being particularly sensitive. Some studies have employed the concept of industrial development to analyse the impact of macroeconomic variables. Song et al. utilised a modified grey relational analysis model to demonstrate that the industrial index exerts a negative effect on CTP, contingent on its location within the pilot market. Zhu et al. postulates that industrial advancement is accompanied by a proportional increase in energy inputs, resulting in an elevated price for carbon trading.

In 2022, China faced a significant economic downturn, which had profound implications for various sectors, including its carbon market. The economic slowdown was driven by several factors, such as stringent COVID-19 lockdowns, disruptions in global supply chains, and a weakened real estate sector. These issues led to reduced industrial activity and lower overall economic output, impacting the demand for carbon credits and the efficiency of emissions reduction projects.

As economic activity dwindled, the carbon market experienced a notable collapse. Lower industrial production meant decreased emissions, leading to a surplus of carbon credits and a subsequent drop in their market value. This oversupply undermined the effectiveness of the carbon trading system, which had been designed to incentivize emissions reductions and drive investment in green technologies. The collapse of the carbon market in China highlighted the vulnerabilities in its environmental policies and raised concerns about the long-term stability and effectiveness of its efforts to combat climate change amidst economic turbulence

4.3 Energy Price

Energy price factors reflect the economy's demand for energy sources that contribute to greenhouse gas emissions, which is internalised in the various regulatory mechanisms and trading schemes that comprise a carbon market. The consumption of energy sources by firms generates a considerable quantity of carbon dioxide, which means that changes in energy prices can have an impact on carbon emissions and, consequently, the formation of a carbon price. The existing literature is in agreement that fossil fuel prices exert a significant influence on CTP, with empirical evidence supporting this assertion. Zhou and Li posit that there exists a long-run equilibrium relationship between CTP and energy prices (Zhou & Li, 2019). In addition, an empirical study led by Sun and Zhang demonstrated that incorporating energy price volatility into the estimation of future carbon prices can significantly improve the accuracy of such forecasts, thereby enhancing their predictive value in this regard (Sun, & Zhang, 2020).

In 2022, fluctuations in energy prices had a significant impact on China's carbon market. As global energy prices surged, particularly for coal and natural gas, the cost of energy-intensive production processes increased. This price volatility led to shifts in energy consumption patterns, with some industries reverting to more carbon-intensive energy sources due to economic pressures.

The rise in energy prices also affected the carbon market by altering the dynamics of emissions and carbon credit demand. Higher energy costs pressured companies to either reduce production or invest in cleaner technologies to mitigate their carbon footprint. In the short term, this resulted in increased demand for carbon credits as firms sought to offset their higher emissions, driving up the price of carbon allowances. Conversely, the economic strain on various sectors also led to calls for regulatory adjustments, which introduced uncertainty into the carbon trading system.

Overall, the fluctuations in energy prices in 2022 underscored the interconnectedness of energy markets and carbon trading, illustrating how external economic factors can influence both the demand for and the stability of carbon credits.

4.4 Policy

The standards for the emission of carbon, policies for the control of emissions and quotas for emissions are all factors that affect the price of CTP. In their study, Zhang et al. examine the relationship between the EU carbon trading system and other policies, including carbon control targets, by analysing the reasons behind the fluctuations in carbon prices over time. Additionally, he proposed that China should coordinate with policy instruments such as Green Certificates and total coal control, while implementing the foundational elements of a carbon market (Zhang, Wang, & Lei, 2020). Zhang et al. posited that China's carbon market remains a regional market, driven by government policy.

A fundamental requirement of China's national emissions trading program is the establishment of an effective Measurable, Reportable, and Verifiable (MRV) system to ensure the transparency and accuracy of greenhouse gas emissions data and to facilitate the verification of emissions reduction targets. This necessitates the implementation of efficient IT systems, robust security measures, and

effective sanctions for instances of non-compliance. These improvements will bolster the confidence of market participants, expand the industry's reach, and secure international backing and legitimacy.

While China has demonstrated progress in enhancing the integrity of its Measurable, Reportable, and Verifiable (MRV) system, there is a clear and pressing need for further improvement. In order for an ETS to be established, an ETS law must be passed at the level of the State Council. Furthermore, in order to ensure the consistency and the high quality of cross-provincial verification, a strong accreditation system for verification agencies must be established. It is also important to ensure that verification costs are sufficient, thereby safeguarding thoroughness. Finally, the MRV regulations and guidelines must be made clearer and more detailed.

It would be beneficial for China to re-examine the MRV best practices observed in the EU ETS and the MRV system utilized in Asia's most prominent ETS, that of Korea. Concurrently, it is of paramount importance to safeguard the integrity of the system from the influence of other policy drivers.

4.5 Other Factors

4.5.1 Consequences of China’s Prolonged Lockdown

The epidemic has had a profound impact on China's carbon market. Since 2020, the Chinese government's lockdown policy on the epidemic has led to a serious lack of expectations for production stability and output, resulting in low incentives to produce. As China's domestic macro-economy is in a downward spiral, the local economy has fluctuated greatly due to the epidemic, making it difficult for enterprises to survive. As a result, enterprises have little confidence in the carbon market and do not pay enough attention to it. This is particularly evident in the second half of 2021 when China implements China's national carbon emissions trading scheme as state-owned power companies gradually withdraw from the carbon market.

4.5.2 Leading Group

One of the fundamental principles underlying the National Carbon Emissions Trading Scheme (NCETS), the Pilot Carbon Emissions Trading Scheme (PCTS), and indeed any prospective carbon market operations, is the standardisation of emissions accounting. At present, China does not possess a uniform methodology for the calculation of greenhouse gas emissions, which has an adverse effect on both the quality and comparability of data across different regions and entities. In August 2022, the National Development and Reform Commission (NDRC) unveiled a detailed plan for the establishment of a unified carbon emissions accounting system throughout the country. This initiative is set to unfold gradually through inter-ministerial collaboration over the course of several years. However, the aforementioned plans will see the Peak Carbon and Carbon Neutral Leadership Group (LSG) assuming responsibility for standardising the relevant processes and confirming their position as the highest authority for the national carbon market. Nevertheless, the aforementioned plans will see the Peak Carbon and Carbon Neutral Leadership Group (LSG) assuming responsibility for this standardisation and confirming its position as the highest authority for the national carbon market. It is anticipated that this could result in delays to the planned expansion of the scope of China's national carbon emissions

trading system, including a potential postponement of the inclusion of further sectors and financial institutions and other non-emitters in trading activities.

4.5.3 Data Integrity

The China National Carbon Market continues to experience significant challenges, with data integrity emerging as a particularly prominent concern.

A mere two months after the market's inauguration, a power plant responsible for approximately 10 million tons of carbon dioxide emissions annually was discovered to have engaged in data manipulation. This incident, which represents a significant instance of fraud, resulted in the alteration of at least 1 million tons of emissions allowances, with an estimated value of approximately $7 million. As reported by the Chinese financial media outlet Caijing, the data issue has resulted in a postponement of the market's expansion into other sectors.

Some commentators have attributed these irregularities to the exceedingly high default value for coal carbon content utilized in the inaugural compliance cycle, which was unveiled in December 2019. The high value was designed to motivate companies to submit authentic test data in lieu of utilizing the default value. However, it was not feasible to advocate for additional testing in 2019, which prompted companies to take the risk of falsifying test reports.

From a broader perspective, a number of factors contribute to an elevated risk of such incidents.

The first issue pertains to monitoring and reporting. It can be argued that the regulations and guidance in place are not sufficiently clear and detailed. For example, there appears to be potential for the manipulation of coal samples during the collection and preparation stages of the testing process for carbon content.

Additionally, the current sanctions regime lacks the deterrent effect desired, as the potential financial gain from committing fraud is significant and the fines, which range from US$3,000 to US$4,500, are relatively insignificant. There is a dearth of clarity surrounding the delineation of responsibilities pertaining to data quality among the various stakeholders, including corporations, verification agencies, testing organizations, and consultancies.

Thirdly, the issue of verification must be addressed. The selection of verification agencies is the responsibility of provincial governments, who tend to favour local agencies. This may result in the exclusion of more experienced and qualified agencies from other provinces. Furthermore, provincial governments are constrained by limited financial resources, which impedes their capacity to cover the costs associated with verification. Additionally, the qualification criteria for verifiers have yet to be established.

4.5.4 Absence of a High-Level Regulation

A further significant challenge for the national carbon market is the absence of comprehensive legislative guidance at the highest level of government. China does not have a comprehensive legislative framework that addresses climate change in a unified manner. Additionally, the country lacks a dedicated law that governs carbon dioxide emissions. Consequently, the carbon emissions

trading system is currently operated in accordance with a set of internal regulations, which have been issued by the Ministry of Energy.

"The ministry regulations are constrained by numerous limitations," stated Zhao Xiaolu, Director of Global Climate Change at the Environmental Defense Fund's Beijing office, in an interview with China Dialogue. For instance, the current regulatory framework lacks the capacity to impose penalties that are sufficiently stringent, thereby creating the potential for companies to incur greater costs in the form of subsidies than fines if they fail to fulfill their market responsibilities.

At present, according to Administrative Measures for Carbon Emission Trading (Trial) published in 2020: In the event that a key emission unit provides false information or withholds pertinent data regarding the emission of greenhouse gases, or otherwise fails to fulfill the obligation to report on these emissions, the competent ecological and environmental authorities at the municipal level or above, as applicable, In the event of non-compliance, the relevant authorities shall order the enterprise in question to implement the necessary corrections within the specified time frame and impose a fine ranging between 10,000 and 30,000 yuan; In the event of a key emission unit's inability to fulfill its financial obligations pertaining to carbon emission quotas within the stipulated timeframe, the relevant ecological and environmental authorities of the municipal-level localities where the unit's production and operational facilities are situated will be obliged to issue an order for rectification. The aforementioned fines will be set at a minimum of 20,000 yuan and a maximum of 30,000 yuan.

5. Conclusion

This paper undertakes a comprehensive review of past research concerning the factors influencing Carbon Trading Prices (CTP), with a particular focus on their impact within China's carbon market during 2022. Our analysis delves into the various elements that have shaped the CTP, offering insights into how these factors have manifested in recent market conditions. We expand on previously identified factors and incorporate new variables that have emerged as significant in the current context.

The review identifies four key factors from the literature that exhibit a notable impact on China's Emissions Trading System (ETS). These factors—historical data, policy frameworks, market dynamics, and economic indicators—each play a crucial role in influencing CTP. Further analysis confirms that these factors have had a substantial effect on the market's behavior and pricing mechanisms.

In addition to these established factors, we propose four new elements that may have significantly influenced the carbon market in 2022. Firstly, the ongoing pandemic and associated lockdown policies have created disruptions in industrial activity and energy consumption, affecting overall emissions and carbon trading dynamics. Secondly, the presence and actions of leading groups or coalitions within the carbon market have impacted decision-making processes and policy implementation. Thirdly, issues related to data integrity, including the accuracy and transparency of emissions reporting, have introduced uncertainty and volatility into the market. Lastly, the absence of comprehensive, high-level legal frameworks has contributed to regulatory ambiguities and inconsistencies, further influencing

market stability and investor confidence.

In conclusion, this study highlights the complex interplay of these factors and their collective impact on CTP in China's carbon market in 2022. The integration of both traditional and newly identified variables provides a more nuanced understanding of the market's dynamics and offers valuable insights for future policy development and market strategies.

6. Policy Recommendation

To enhance the effectiveness and stability of China's carbon market, we propose the following policy recommendations across two key areas:

1) Improving Management Team Efficiency by create specialized task forces within regulatory bodies focused solely on the carbon market

These task forces should consist of experts in environmental economics, market analysis, and policy implementation. By concentrating expertise, these teams can more effectively address market challenges, streamline operations, and make informed decisions. Also, government need to invest in ongoing training and professional development for staff involved in carbon market management. Ensuring that team members are well-versed in the latest market practices, technologies, and regulatory changes will improve their ability to manage the market effectively and respond to emerging challenges.

2) Enacting Effective Legislation by introducing and enforcing robust legal frameworks specifically tailored to the carbon market

These laws should address key areas such as emissions reporting standards, market conduct, and enforcement mechanisms. Clear and comprehensive regulations will provide a stable foundation for market operations and enhance investor confidence. Also, government should Implement stringent penalties for non-compliance with carbon market regulations. This includes penalties for inaccurate emissions reporting, fraudulent trading practices, and failure to meet reduction targets. Strong enforcement measures will deter misconduct and ensure that market participants adhere to established rules. Last, government need to mandate regular public disclosure of carbon market data, including trading volumes, price trends, and emissions reports. Transparency in market operations will enhance accountability, build public trust, and provide stakeholders with the information needed to make informed decisions.

By focusing on these two areas—improving management efficiency, enacting effective legislation—China's carbon market can become more effective, transparent, and resilient, ultimately contributing to the country's broader environmental and economic goals.

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