

Impacts of Fossil Fuel Price Fluctuations on Carbon Emission Trading Prices in China

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Abstract. This study comprehensively reviews multiple research regarding the impact of fossil fuel price fluctuations on carbon emission trading prices. Presently, coal is the largest energy source in China and the largest contributor to carbon emissions. However, as the green economy develops and the global landscape changes, requirements for carbon emissions grow stricter. The manufacturing industry in China is booming while enterprises related to the carbon market are facing immense pressure to reduce emissions under the mechanism of carbon pricing and trading. Fossil fuel use is the largest source of carbon emissions in China. Therefore, carbon trading mechanisms and carbon tax policies are key cost factors for the enterprises involved. This study aims to discuss the impact of fossil fuel price fluctuations on carbon emission trading prices in China, draw relevant conclusions, and propose corresponding suggestions. From the government's perspective, they can establish a dynamic adjustment mechanism for carbon emission trading prices. Meanwhile, enterprises should establish a mechanism to forecast carbon emission trading prices, enabling them to comprehensively manage the impact of price fluctuations driven by changes in fossil fuel prices.

Keywords: Fossil fuels; carbon emission allowances; green economy.

1. Introduction

Ever since the reform and opening up, China has made significant achievements in terms of economic and energy development. In recent years, China's economy has been transitioning from rapid growth to high-quality development, with fossil fuels playing a significant role in its progress. Power generation through the combustion of fossil fuels is the largest source of carbon emission in China. However, due to the direct requirements of China's dual carbon goal, industries related to the carbon market are facing overwhelming emission reduction pressure [1]. The economic mode of developing an economy based on the extensive use of fossil fuels has caused a series of problems, such as deteriorating environmental pollution and excessive resource consumption.

Nowadays, China is a responsible major power across the international community, playing a leading role in global governance. After 46 years of reform and opening up, China is at the critical stage of economic restructuring, and green economy development is recognized as the core aspect of the ongoing economic transformation and upgrading process [2]. During this stage, the trading of carbon emission allowances is one important means to achieve the dual carbon goal.

In October 2011, the General Office of the National Development and Reform Commission (NDRC) of China issued the Notice on Launching Pilot Programs for Carbon Emission Trading. Since then, carbon emission trading has been progressively piloted with carbon trading markets being established in Beijing, Shanghai, and Tianjin. On July 16, 2021, trading in the national carbon emission trading market officially commenced. Currently, enterprises related to the carbon market are taking on increasingly important responsibilities. Among these involved enterprises, their wide use of fossil fuels becomes the largest source of carbon emission. From their perspective, fluctuations in fossil fuel prices will produce impacts on their carbon emission more or less.

Many current studies still focus on the following aspects: integrating green energy into the frameworks of carbon finance and carbon market while ensuring sustainable development; the development of green finance and green economy policies; the impact of green development on corporate performance and results. Carbon emission trading, as a complex issue, represents an emerging area of research in the field of finance. Gou indicated that green finance and green economy

have been the most important areas of building China into a strong financial power. Tasks on carbon peak and carbon neutrality are progressing, demonstrating a positive trend of booming and rapid growth. According to Huang, policies regarding the green economy possess strong robustness. Meanwhile, financial support and policy systems for low-carbon development have become increasingly mature [3]. However, studies on influencing factors of carbon emission trading prices in China are relatively limited, with the system still underdeveloped, especially when considering the impact of fluctuations in fossil fuel prices. Hence, this study will summarize and synthesize the impact of changes in fossil fuel prices on carbon emission trading prices in China. This study starts with a review of the historical development of fossil fuel use in China. Then the current pricing of fossil fuels is analyzed, which is followed by the discussion of the impact of changes in fossil fuel prices on carbon emission trading prices in China. It concludes at the end and reveals the development trends and challenges faced by enterprises in carbon emission trading.

2. Current Pricing of Fossil Fuels

2.1. Development Progress

As one of the top countries in fossil fuel consumption, China owns a substantial fossil fuel market. It continues to witness an upward trend in fossil fuel prices, which is deeply influenced by price fluctuations in the global market and international economic and political landscape.

After organizing and reviewing major events in the recent decade, changes in fossil fuel prices are summarized. From around 2014 to 2016, the development of shale oil technology in the United States led to the excessive supply of oil and other fossil fuels to a certain extent. International oil prices dropped from a high of USD 100 per barrel to less than USD 30 per barrel in early 2016. To deal with the fall in oil prices, the Organization of the Petroleum Exporting Countries (OPEC) and some non-OPEC countries reached an agreement to reduce production, thereby lowering global supply and increasing oil prices. In 2018, the oil price returned to USD 80 per barrel. However, the outbreak of the Russia-Ukraine war in 2022 caused renewed turbulence in the global fossil fuel market. Sanctions against Russia and other factors led to a price surge of natural gas and oil. Europe was under deep influence with prices of natural gas and oil spiking to record highs.

2.2. Influencing Factors

Fluctuations in fossil fuel prices are influenced by multiple complex factors, which are interconnected and collectively affect fossil fuel prices. Data and indicators in multiple aspects (such as OPEC crude oil reserves, the S&P 500 oil index, the Dow Jones Industrial Average, and other factors that can influence fossil fuel prices) are comprehensively analyzed through the review of existing research and literature. It is found that the major influencing factors of fossil fuel prices consist of the law of supply and demand, exchange rates, crude oil prices, geopolitical events, policy and regulations, technological advancement, and economic conditions [4].

The law of supply and demand is one of the key factors that influence fossil fuel prices, which is also applicable to the prices of fossil fuels. Price changes of the influential commodity can reflect changes in market supply and demand. The exchange rate is an economic variable in international trade, with most transactions predominantly denominated in US dollars. If a country's currency depreciates, its exported goods become cheaper in the international market, attracting buyers from other countries. The principle is also applicable to the global fossil fuel market. As an important participant in the global market, China relies heavily on fossil fuel imports and is susceptible to international prices. Geopolitical events directly challenge energy-intensive enterprises by driving up fossil fuel prices, which increases their energy costs. Meanwhile, it is difficult for enterprises involved to find alternative energy sources, which results in higher carbon emission costs. This affects the overall momentum of the carbon market and reduces the role of the carbon emissions trading market in promoting emission reductions.

Fluctuations in fossil fuel prices also adds the difficulty to the pricing of carbon emission allowances in the carbon trading market. The uncertainty of pricing also causes risks for market participants, making it difficult for them to predict the carbon prices. This hinders the ability of involved enterprises to conduct long-term investment analysis and decisions.

The fluctuation of fossil fuel prices impacts the supply-demand balance of the carbon emission trading market as well. When prices rise, enterprises seek low-carbon technologies and viable alternative energy sources, reducing the demand for carbon emission allowances and ultimately lowering prices. In turn, lower carbon trading prices encourage enterprises to purchase carbon emission allowances rather than reduce emissions, develop clean energy, and protect the environment. In recent years, carbon trading prices in China have continued to decline, hindering the effectiveness of carbon reduction efforts. The progress of establishing the carbon trading market is relatively slow and the design and operation of carbon trading mechanism is facing tough challenges. Regional conflicts also exert an influence on fossil fuel prices. Wars, conflicts, and terrorist attacks directly disrupt the production or transportation of fossil fuels, such as attacks on oil refineries, oil pipelines, and oil storage facilities, causing supply shortages in the market and a rise in oil prices subsequently. Furthermore, the blockage of key transportation routes drives up fossil fuel prices. For instance, the obstruction, slowdown, or suspended navigation in the Suez Canal, the Strait of Hormuz, and the Panama Canal due to various reasons will impact the fossil fuel prices in countries that rely heavily on energy imports, including China. Fossil fuel prices are also affected by technological advancement. For instance, the aforementioned breakthrough of shale oil technology from around 2014 to 2016 led to an oversupply of oil and other fossil fuels, which caused fossil fuel prices to fall.

2.3. Influencing Factors

Carbon emission trading is a market mechanism that can promote the emission reduction of global greenhouse gases. On May 9, 1992, the United Nations Framework Convention on Climate Change (UNFCCC) was passed by the General Assembly of the United Nations. In December 1997, the Kyoto Protocol, as the additional protocol to the UNFCCC, was passed. It officially established a new approach to addressing greenhouse gas issues, primarily carbon dioxide, through the introduction of market mechanisms. Carbon emission trading, also known as carbon trading, trades the emission allowances of various greenhouse gases represented by carbon dioxide.

The carbon emission trading market is increasingly developed and mature. Since the official launch of the carbon emission trading market in July 2021, its registration, transaction, and settlement systems have become increasingly developed; relevant regulations have been further specified; regulations on market participants have also been gradually improved.

Regional economic disparities across China have been reduced. The market not only promotes enterprises to improve their equipment to reduce carbon reduction, positively impacting regional carbon output, but also promote the cross-regional flow of resources. These developments have been playing a positive role in diminishing economic gaps of different regions [5].

The carbon market is being financialized. As the carbon emission trading market continues to grow and develop, financial products and relevant services of carbon trading gradually emerge. The emergence and development of green finance products, such as futures, green bonds, and funds, have enriched the carbon emission trading market system, enhancing its complexity and professionalism [6].

3. Impact of Fossil Fuel Price Fluctuations on Carbon Emission Trading in China

In China, the impacts of fossil fuel price changes on carbon emission trading prices are evident in many aspects. For instance, in regions that are dominated by thermal power generation, price increases of fossil fuels, such as coal, lead to a rise in power generation costs. Subsequently, electricity prices increase, reducing the electricity consumption of industrial users and residents. This lowers the

overall energy consumption and carbon emissions of these regions, reducing the market demand for carbon emission allowances. If electricity prices fall due to the price reduction of coals, more electricity might be consumed, leading to the intensification of carbon emissions as well as the market demand for carbon emission allowances [7]. Furthermore, fluctuations in fossil fuel prices in the international market also affect China's carbon emission trading market. Since China is heavily dependent on fossil fuel imports, price changes in the international market will affect domestic fossil fuel prices, producing an impact on the market prices in China's carbon emission trading market.

The cost substitution effect in corporate behavior demonstrates the most significant and direct impact of fluctuations in fossil fuel prices on the carbon emission trading market in China. The combustion of fossil fuels is still a major source of energy and power. When fossil fuel prices rise, corporate costs increase. Further driven by the carbon market, enterprises tend to proactively shift to cleaner or lower-cost energy sources. However, when prices of traditional fossil fuels are relatively low and related costs are lower than those of alternative options, profit-driven enterprises will still prefer traditional energies even with the existence of the carbon emission trading market. Hence, the demand for carbon emission allowances increases, further elevating its price [8].

One impact of fluctuations in fossil fuel prices on the carbon emission trading market in China is the resulting changes in policies and the market. Since the official launch of the carbon emission trading market, relevant laws, policies, and regulations have been introduced. Energy subsidies, tax-related measures, or other temporary, unpredictable measures in many industries are directly associated with carbon emission trading. Higher fossil fuel prices encourage enterprises to accelerate their green transformation and increase investment in related technologies to mitigate excessive reliance on carbon emission allowances that drive up their costs. This, in turn, decreases the demand for carbon emission allowances and lowers their trading prices.

Marginal abatement cost is also a significant aspect of the impact of fossil fuel price fluctuation on the carbon emission trading market in China. It is a key influencing factor of carbon emission trading prices. Marginal abatement cost refers to the cost of reducing an additional unit of carbon emission. When fossil fuel prices increase, marginal costs of consuming them rise as well. As a result, enterprises are more likely to purchase carbon emission allowances for their manufacturing process [9].

4. Challenges of Carbon Emission Trading Caused by Fossil Fuel Price Fluctuations

4.1. Challenges

Enterprises face many challenges in the carbon emission trading market, with the major one being their massive demand for carbon emission allowances. The massive demand drives up their manufacturing costs, especially for those with high carbon emissions. This places immense pressure on their operations and development. Meanwhile, established in 2021, China's carbon emission trading market is still at the primary development stage with insufficient liquidity and high price volatility. Relevant schemes and regulations still need further refinement.

Nevertheless, price changes in fossil fuels also pose multiple challenges to the carbon emission trading market, primarily affecting market operations, emission reduction, and economic transformation.

4.2. Countermeasures

Participants of the carbon emission trading market should jointly address the challenges caused by price changes in fossil fuels, including governments, enterprises, other participants, and the international community.

The government should take the lead in the carbon emission trading market. A dynamic adjustment mechanism of carbon emission trading price can be established and further improved. By setting the

price range, it can help reduce extreme price fluctuations and enhance the stability of the market. In addition, enhancing the coordination between relevant emission reduction policies can help ensure mutual support between measures such as taxation, subsidies, policies, and incentives and the carbon emission trading market mechanism.

Enterprises should improve their emission reduction goals and forecast carbon emission trading prices based on market conditions. They should capture relevant market signals of the carbon emission trading market to the fullest extent and establish a forecasting mechanism for carbon emission trading prices. This will facilitate the long-term planning and decisions of enterprises, thereby mitigating uncertainty in decision-making due to short-term price fluctuations.

China can leverage its image as a responsible major power across the international community to promote international cooperation. International coordination and cooperation on the pricing of carbon emission allowances should be strengthened to promote compatibility between carbon markets across countries. This will encourage the international community to jointly address the challenges and strive for a better future.

5. Conclusion

This study comprehensively examines existing research and summarizes the impact of fluctuations in fossil fuel prices on carbon emission trading prices in China. It starts by summarizing the usage of fossil fuels in China, and then the potential economic impacts caused by fossil fuel price changes are analyzed based on existing literature and research. Price changes in fossil fuels bring twofold economic impacts. The positive impacts include that it can propel the rapid growth of the economy, advance industrialization, and lower manufacturing costs when prices fall. However, decreased prices stimulate the wide use of fossil fuels, which causes environmental pollution and deterioration. Accordingly, more economic inputs are required, hampering economic development. Fluctuations in fossil fuel prices exacerbate the instability of the carbon emission trading market, obstructing economic stability.

Following that, the current pricing of fossil fuel prices and influencing factors of fossil fuel prices are discussed, which include the law of supply and demand, exchange rates, crude oil prices, geopolitical events, policies and regulations, technological advancement, and economic conditions. The impacts of fluctuations in fossil fuel prices on carbon emission trading are analyzed, which are manifested in corporate behavior, policies and market changes, and marginal abatement costs. This study concludes with challenges brought by the price changes in fossil fuels and countermeasures to address these challenges.

For the challenges of carbon emission trading due to fossil fuel price changes, this study proposes the following potential countermeasures. Regarding the instability of the carbon emission trading market, a dynamic adjustment mechanism of carbon emission trading price can be established and further improved. Regarding the uncertainty of the carbon emission trading market, enterprises can try to establish a forecasting mechanism of carbon emission trading prices to facilitate long-term planning and decisions. Furthermore, countries around the world should strengthen cooperation, coordinate the pricing of carbon emission allowances, and improve the compatibility of carbon emission trading markets across the globe. This study is a literature review that draw on previous studies and research, without the adoption of more reliable mathematical methods.

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