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Carbon Pricing in Economic, Environmental, and Social (EES) Factors: A Bibliometric and Content Analysis

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Abstract: *Carbon pricing, often called the trading price of carbon emission rights, plays a crucial and dynamic role in the carbon market. Despite its importance, comprehensive studies that examine carbon prices within the broader context of the emerging low-carbon economy remain limited. This paper adopts a mixed-method approach, combining bibliometric and thematic analyses to explore the Economic, Environmental, and Social (EES) impacts of carbon pricing as discussed in existing research. Moreover, the study introduces a conceptual framework through these lenses to identify and analyse emerging topics related to carbon pricing. The analysis reveals a marked increase in scholarly attention to this subject since 2021, with key themes centred around environmental economics, particularly climate change and pollution taxes. Current research predominantly focuses on carbon emissions and emissions trading systems, while theoretical discussions engage with concepts such as compliance cost theory, Porter's hypothesis, and market signal theory. The paper concludes by reflecting on the broader implications of carbon pricing for the economy, environment, and society.*

Keywords: carbon pricing, environmental, economic, carbon emission reduction

1. Introduction

Carbon pricing refers to the monetary value assigned to releasing carbon dioxide (CO_2) and other greenhouse gases into the Earth's atmosphere. The carbon market is an environmental mechanism that operates on market principles and aims to decrease carbon emissions by establishing a price (Mehling & Tvinnereim, 2018). Carbon prices can be established by implementing either a carbon tax or a cap-and-trade mechanism, often known as carbon trading. Under a cap-and-trade system, corporations have restrictions on the quantity of carbon they can release and have the option to purchase or sell carbon permits (Barnett et al., 2020).

Establishing carbon trading prices can be categorised into two groups based on distinct trading methods. The first group involves buyers and sellers participating in continuous public bidding in the carbon trading market, where they agree on the trading volume and price throughout the bidding process. The second type of market is established within the voluntary carbon trading market and the Clean Development Mechanism (CDM) primary market. In this market, the two parties involved in the transaction negotiate and agree upon the price and emission

reduction project based on a contract. The buyer holds the power to determine the prices of the transaction.

Researchers have recently extensively studied the concept of carbon prices through theoretical and empirical investigations. Narassimhan et al. (2017) performed a comprehensive examination of carbon price policies in 15 different regions. These regions included the European Union, Switzerland, Ireland, Norway, the Regional Greenhouse Gas Initiative (RGGI), and China's carbon trading pilot scheme. Ji et al. (2018) conducted a comprehensive examination of the mechanisms and factors that influence the creation of carbon market prices. Ji et al. (2019) employed bibliometric techniques to thoroughly examine the attributes of carbon prices inside carbon emissions trading schemes. Maestre-Andrés et al. (2019) presented an extensive examination of the perceived equity and societal approval of carbon prices, encompassing existing research in the field. Thube et al. (2021) conducted a comprehensive analysis of carbon prices' economic and environmental advantages, which were quantitatively assessed using economic models. Ye (2022) examined the prices of carbon market spots and futures trading.

These literature reviews offer a limited and specific synthesis of research on carbon prices, focusing on a single perspective, a particular location, or a fixed timeframe. However, they do not provide a full overview of the extensive literature on the various impacts of carbon prices. This paper aims to address this gap by utilising the Cite Space visualisation tool and content analysis method to systematically categorise the multiple effects of carbon prices across economic, environmental, and social dimensions. The objective is to offer a valuable resource for future researchers and policymakers.

This study aims to conduct a comprehensive assessment and bibliometric analysis of the existing literature about the various impacts of carbon prices. The paper will explore the following research inquiries.
a. What are the patterns in the quantity of publications produced within the research field?
b. Which authors, publications, and subject areas dominate the current research area?
c. What are the current areas of focus in the field of research?

The paper is structured in the following manner. After the introduction, the second section provides details about the process of collecting data and the technique used for the research. The third section focuses on doing a character metric analysis of the literature. The fourth component entails a comprehensive examination of the literature regarding content measurement. The fifth section examines the developing themes related to carbon prices. Lastly, the sixth section provides the study's conclusions and outlines potential avenues for further research.

2. Data Collection and Research Methodology

2.1 Data Collection

This study conducts a comprehensive search of the English language literature in the Web of Science Core Collection and Scopus databases, covering the period from 2000 to July 2024. The search focuses on articles that discuss the concept of carbon price. The literature consists exclusively of journal articles, excluding any unrelated sources such as conferences, reviews, monographs, etc., to ensure the study samples' accuracy and dependability. Specifically, in the Web of Science Core Collection database with ALL= ("carbon price*" OR “carbon prices") AND ("company value" OR "productivity" OR "financial performance" OR "carbon

reduction*" OR "environment, society, governance*" OR "technological innovation "OR "innovation*" OR "employment" OR "equity" OR "income") were used as search terms to retrieve a total of 1085 documents. Likewise, the Scopus database was searched using the same search criteria, which yielded 878 articles selected based on their title, abstract, and keywords. To ensure the relevance of the literature, this work meticulously examined each retrieved item individually, resulting in the acquisition of 68 pieces of literature after data cleansing. The technique of retrieving and filtering literature is illustrated in Table 1.

Table 1: Literature Screening Process

Literature Search	Databases	
	Web of Science	**Scopus**
Last retrieval time	28th July 2024	28th July 2024
Document Type	Article	Article
Search Topics	("carbon price*" OR " carbon prices") AND ("company value" OR "productivity" OR "financial performance" OR "carbon reduction*" OR "Environment, society, governance*" OR "technological innovation " OR "innovation*" OR "employment" OR " equity" OR "income")	
Number of searches	1085	878
Literature Screening	Excluding literature that is not relevant to the impacts of carbon emissions trading policies	
Number of post-screening literature	30	38
Literature period	1 January 2000-28 July 2024	
Final Number of Literature	68	

2.2 Research Methods

This work employs both bibliometric and content analysis methodologies. Knowledge graph analysis primarily utilises citations, co-citations, clustering, and word frequency analysis to delve into the development process, research hotspots, and cutting-edge trends of specific research to gain more comprehensive insights. The primary software tools typically employed to examine knowledge graphs include Cite Space, VOS Viewer, Bib Excel, and Hist Cite. One of the software options, Cite Space, can rapidly generate knowledge graphs and has excellent visualization capabilities. As a result, it is increasingly becoming the dominant software for analysing knowledge graphs. This study utilises Cite Space software to perform a scientific metric analysis of studies about the carbon price. The objective is to identify the areas of active research and the latest advancements in related subjects.

Contents analysis is a widely used qualitative method that tries to get insights into the specific state of study by systematically examining, summarising and describing the fundamental substance of literature. It analyses the underlying features of the literature on a research topic. It elucidates the present state of development in that area by considering the specific content of the literature. However, the method is constrained by the limited sample data from the literature and is prone to subjectivity. This article utilises a mixed research strategy that combines quantitative and qualitative methodologies to investigate the various impacts of carbon prices and future research directions.

3. Analysis of Literature Characteristics

The econometric study of literary features examines five specific components of the carbon price literature: the number of publications, statistics related to the journals in which they are published, collaborative networks among authors, analysis of the contribution of keywords, and analysis of the abruptness of keywords.

3.1 Time and Number of Publications

The number of articles in the literature can partially indicate the pace and progression of research about carbon prices. Based on the annual trend chart in Figure 1, the first literature on carbon price studies was released in 2014. The quantity of published works and the frequency of citations regarding the various impacts of carbon prices have shown significant and quick growth since 2021. There are 10 articles published in 2020 or earlier, 15 pieces published in 2021, 11 articles published in 2022, 17 articles published in 2023, and 15 articles published in the first half of 2024. Recent years have seen a surge of interest in studying the diverse consequences of carbon prices, with scholars actively investigating the effects of carbon prices on different parts of society.

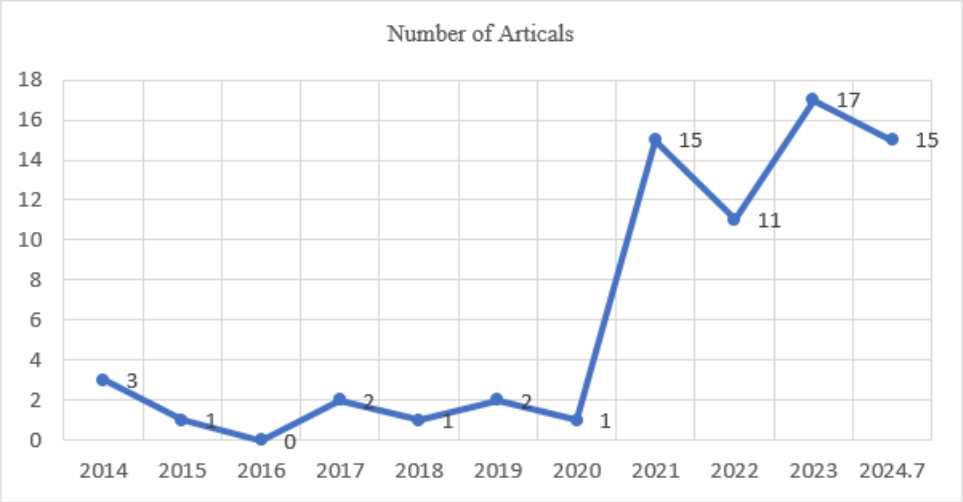

Figure 1: Number of Articles from 2000 to 2024.7

3.2 Literature Published in Journals

An analysis of 68 articles revealed that 34 journals contributed to the literature. Overall, the number of journals in the field of multiple effects of carbon prices is high, but their distribution is dispersed. It is worth mentioning that nine journals, which account for 26.47 %, published only one article on this topic. These publications encompass several fields, including environmental science, ecology, environmental management, and energy economics. Top journals in the field include the Journal of Cleaner Production, Energy Policy, Energy Economics, and Journal of Environmental Management. The Journal of Cleaner Production had the highest number of publications, with 6 articles, accounting for 17.65%. Environmental and Resource Economics had the second-highest number of articles, totalling 5 and accounting for 14.71% of the total publications.

3.3 Author Co-Citation Analysis

This work examines the co-citation of authors in 68 papers within the field of research on the many effects of carbon prices. Author co-citation is the occurrence of two or more writers being cited simultaneously in multiple academic works. Author co-citation mapping is a valuable method for analysing the development of research teams on a specific topic. This study utilised Cite Space software to analyse the authors of the cited literature for co-citation. We specifically selected the node type as Cited Author. As a result, this study acquired the author's co-citation map of the sample data presented in Figure 2. The node size representing the author's name indicates the number of citations, while the visibility of the connecting line between nodes indicates the level of importance.

Based on the co-citation analysis graph conducted by the authors, it is evident that Cai, W, Wang, C, Zhao, Y, and others have received a higher number of citations. Furthermore, the scholars mentioned above exhibit a greater level of collaboration and have more frequent interactions with each other. Author co-citation mapping reveals a complex hierarchy of co-citation relationships, characterized by the formation of stable author clusters and frequent collaborations among scholars. The authors that have the highest citation frequency demonstrate a significant level of centrality within the collaborative network, further confirming their importance and contribution to research in the topic of carbon prices.

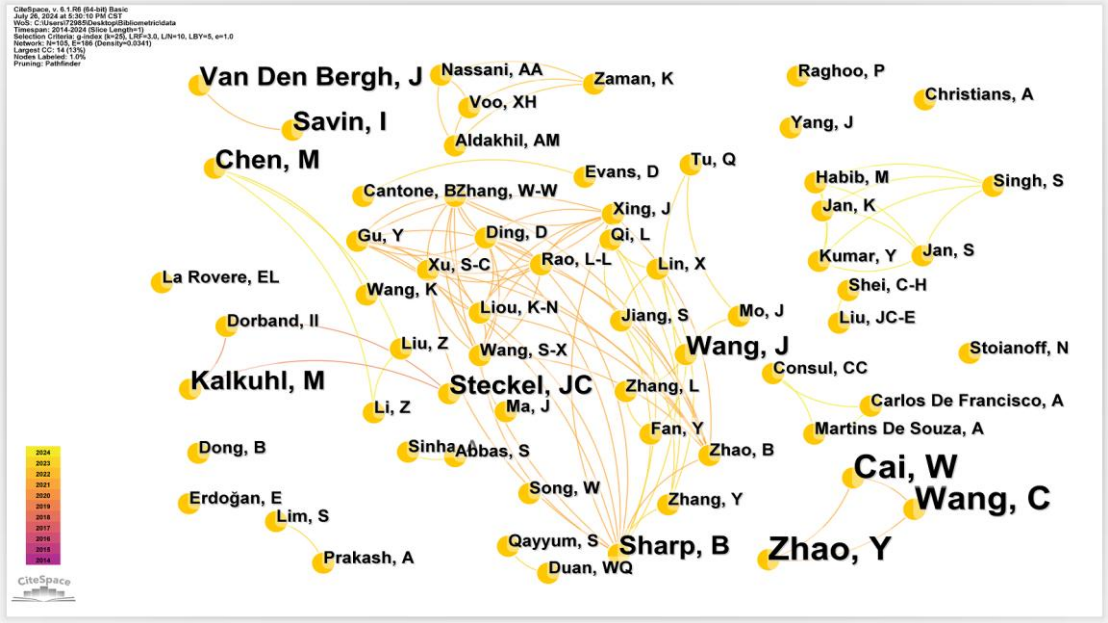

Figure 2: Author Co-Occurrence Analysis

4. Literature Content Measurement Analysis

4.1 Keyword Co-Occurrence Analysis

Keywords provide a brief and precise summary of the major substance of literature. They indicate the relevance of literature to a specific topic area and can disclose the inherent connections between different areas of knowledge. Additionally, keywords are commonly used to analyse and identify trends in a particular field. This work utilises the Cite Space software to analyse the field of carbon price research. The node type selected is Keyword, with a Time Slicing period of 2000-2024 and Years Per Slice set to 1. The result is a keyword covariance mapping, as shown in Figure 3.

The frequency and centrality of keyword occurrences positively correlate with the level of shared interest among researchers and can effectively depict the prevailing research areas. Among which the top five keywords are carbon prices, carbon emission, climate change, emissions trading, and pollution tax and so on. Further analysis of the keyword centrality ranking shows that the keywords with higher centrality include carbon emission, emission control, climate change, emissions trading and so on.

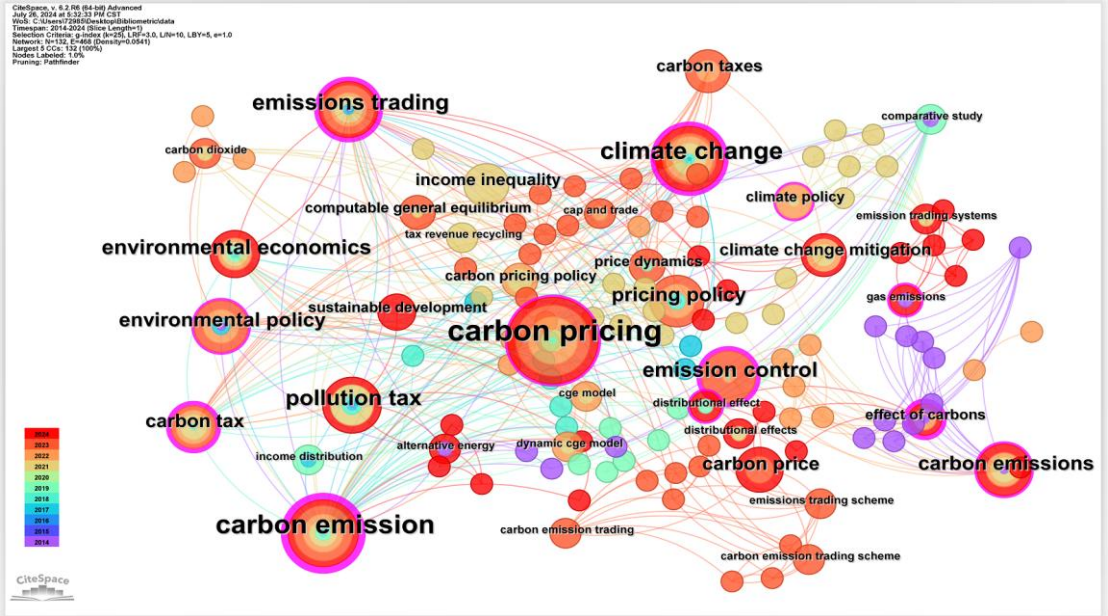

Figure 3: Keyword Co-Occurrence Analysis

The research on the various impacts of carbon prices may be categorized into three topics based on the distribution of keyword co-occurrence results and the research technique and data sources employed by the researchers. a) The impact of carbon prices on economic growth, obtained through keywords such as environmental economics and pollution taxes. b) The environmental consequences of carbon prices, as determined by analysing the terms climate change and carbon emission .c) the social impacts of a carbon price, obtained through keywords such as income distribution and distributional effects.

4.2 Keyword Emergence Analysis

This paper uses the Cite Space program and configures the parameters to analyse burstiness, generating the term emergence map as depicted in Figure 4. Emergence strength measures how often a keyword emerges, and a higher emergence strength indicates a more robust representation of the research frontiers in the subject. Begin and End indicate the start and end years of the keyword becoming a hotspot, respectively. The dark line segment's length indicates the keyword's duration becoming a research hotspot.

As seen in Figure 4, firstly, in terms of the intensity of emergence, income inequality is the term with the highest degree of emergence in carbon price research. In 2021, there are 10-15 major and minor carbon trading markets worldwide. During this time, a growing number of researchers have started investigating the influence of carbon prices on revenues, making it a prominent area of research. Secondly, regarding the chronological appearance of emerging phrases, it is noteworthy that keywords such as income distribution, environmental economics, price policy, and pollution tax emerged earlier. This indicates that as the carbon market evolved, scientists-initiated studies on carbon prices. Thirdly, regarding the temporal

distribution of the emerging words, the terms carbon tax, carbon price, emission control, and carbon emissions trading have consistently remained significant up to the present time. This suggests that the focal points and research trends in this area continue to focus on the present and future periods. Fourthly, the very short duration of research, often spanning one to two years, indicates that the topic of carbon prices is abundant with scholarly investigations and progressing rapidly.

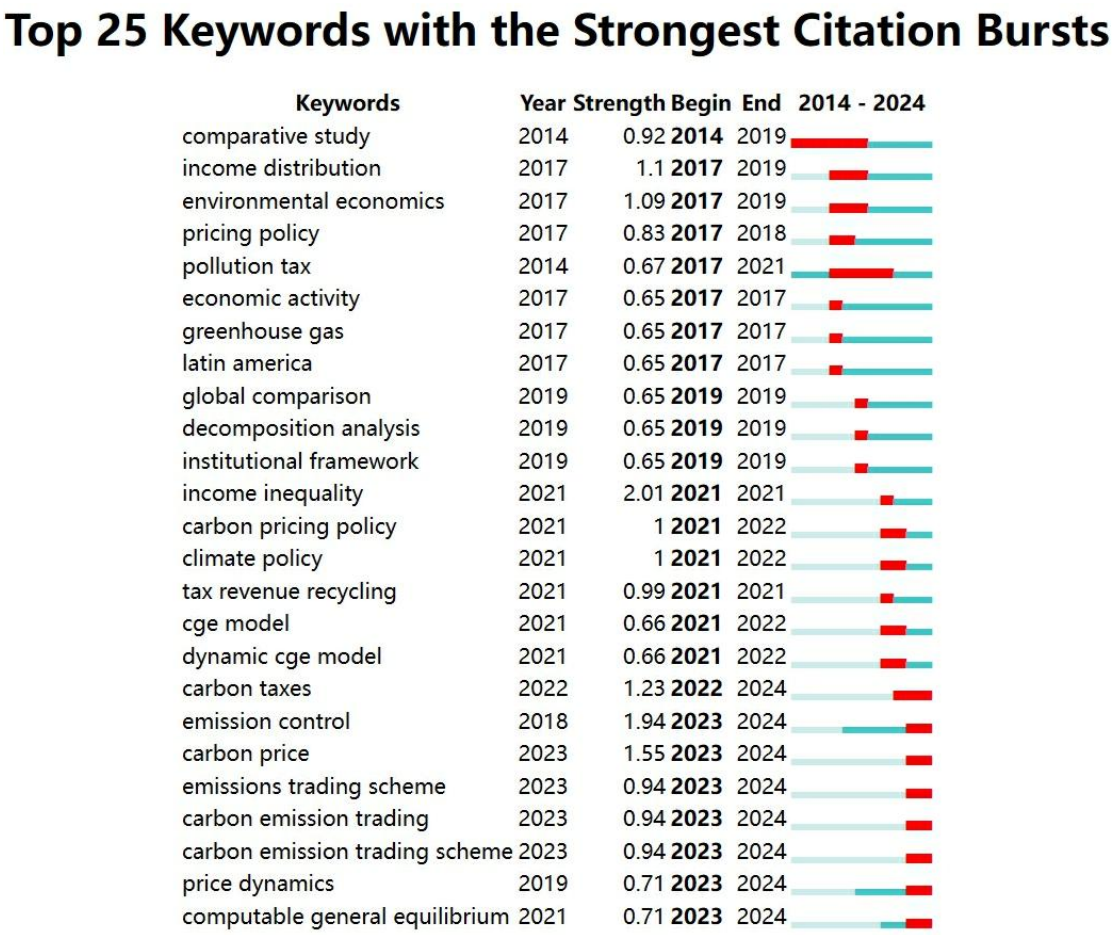

Figure 4: Keyword Emergence Map

4.3 Further Analyses Based on the Content of the Literature

4.3.1 Analysis of Literature Theoretical Perspectives

The existing body of research on carbon prices has mainly examined three fundamental theories: the theory of compliance costs, Porter's hypothesis (the theory of incentivizing innovation), and the idea of market signalling.

Neoclassical economics posits that stricter environmental regulations result in increased expenses for companies, hinder the capacity to innovate in an environmentally friendly manner, diminish the competitiveness of corporations, and adversely affect the overall economic progress of a nation (Arrow, 2015) . According to the principle of compliance costs, Zhang et al.(2018) assess the influence of carbon prices on the market value of energy businesses in several pilot regions of China. They discover that carbon prices have a noteworthy adverse effect on the stock value of these companies, with the magnitude of the impact differing across

different markets. Krokida et al. (2020) emphasised that the rise in the cost of CO_2 emission permits hurts overall stock returns in European stock markets.

In 1995, Porter and van der Linde conducted a case study that supported the idea that well-designed and stringent environmental regulations can motivate companies to innovate. They also found that the benefits of innovation can help offset the expenses of complying with environmental regulations, leading to increased competitiveness for firms. This creates a mutually beneficial situation for both the environment and the economy (Porter & Van Der Linde, 1995) . Academics refer to their view as the Porter hypothesis. Based on the theory of the Porter hypothesis, Flachsland et al. (2020) pointed out that the EU ETS introduces a minimum carbon prices norm, a significant institutional innovation. This innovation is crucial in improving political and economic stability and maintaining price stability within the EU ETS.

Wu and Wang (2022) indicated that the carbon price represents the additional cost of carbon emissions, and an increase in the carbon price will result in higher expenses for the company. Companies can enhance their productivity and decrease emissions by employing essential techniques such as developing innovative green technologies and optimising the allocation of resources. Implementing these measures can significantly increase a company's overall productivity.

In his influential work "Market Signaling: Signaling in the Employment Process" published in 1973, Spence had a pioneering role in the development of the area of market signaling. This book garnered significant attention within the realm of Western economics (Spence, 1978). Market signals are crucial economic indicators that play an important role in guiding the decision-making process of market participants. As market participants, firms frequently require diverse market information to support their corporate decision-making and make appropriate decisions. Subsequently, their economic choices introduce fresh indications into the market, so impacting the financial decisions of other market participants (Morris, 1987). Carbon price signals are a crucial form of market indication. The carbon price serves as a complicated and changing price signal in the carbon market, providing information feedback. The fundamental purpose of the carbon market is to utilise market mechanisms, remarkably the carbon price, to direct high carbon-emitting firms towards energy conservation and emission reduction (Zhu et al., 2019). Carbon prices serve as a primary means of generating government money, providing clear signals to companies regarding which emissions reductions to pursue and which carbon permits to purchase.

To summarise, while there is a wealth of research on carbon prices, it primarily consists of thorough applications of theories from many disciplines. However, there is a dearth of in-depth study of theoretical viewpoints and limited theoretical innovation.

4.3.2 Analysis of Literature Research Methods

The study of the various impacts of carbon prices has gained significant attention in recent years and is a crucial area of study within the science of economics. The present research mainly focuses on quantitative methods, and this paper provides a concise overview of the existing literature from a quantitative research standpoint. Presently, carbon prices studies employ several different approaches, including the Difference-in-Differences technique (DID), the Propensity Score Matching and Difference-in-Differences methods (PSM-DID), computable general equilibrium models, and input-output models.

Researchers frequently employ DID and PSM-DID models to analyse the effects of carbon prices on economic growth and carbon emission reduction. Wu (2022) discovered that the rise in carbon price and the increase in trade volume had a consistent and substantial impact on reducing CO_2 emissions, as observed by a continuous DID model. Wu and Wang (2022) employed the DID model to examine the effects of China's carbon price stabilisation mechanism on total factor productivity (TFP). Their findings revealed a considerable rise in TFP due to this mechanism. Dong et al. (2021) utilised the PSM-DID model to examine the impact of carbon price on the financial performance of regulated firms. They discovered that an increase in carbon price positively affects financial performance, while higher volatility has a negative effect. Furthermore, they observed a positive correlation between China's carbon emissions trading mechanism and firms' economic performance.

Researchers typically apply computable general equilibrium models to analyse the effects of carbon prices on income distribution, macroeconomics, and employment. Lin and Jia (2019a) conduct a comprehensive evaluation of the determinants impacting the cost of carbon trading using a computable general equilibrium model. They thoroughly investigate the process via which these influences occur. Chepeliev et al. (2021) analyzed the effects of carbon price regulations on the distribution of resources using a dynamic computable general equilibrium model. Zhao et al. (2022) conduct a thorough evaluation of the correlation between carbon price regulations, income recycling programs, and income inequality in China. They employ a dynamic computable general equilibrium model to do this.Zhang et al. (2023) investigated the effects of the carbon prices mechanism on income distribution in China using a computable general equilibrium (CGE) model. The findings indicate that the carbon prices mechanism has a progressive impact on income distribution and a varied impact on the income of urban and rural workers.

Utilization of input-output methodologies. Choi et al. (2010) utilized an input-output methods to investigate the effects of carbon prices on various economic sectors, resource utilization, and emissions within the United States. Yan and Yang (2021) employed an environmentally extended input-output model to examine the relationship between carbon prices and residents' income. They specifically utilised the Suits index to quantify this correlation. Chen and Wang (2023) developed 12 distinct scenarios by integrating Data Envelopment Analysis (DEA) and Multiobjective Optimization (MBP). These scenarios were used to assess the effects of carbon prices and technological advancements on reducing emissions and the additional production costs for industrial companies in China. The study examined these impacts when carbon prices and technological innovations were implemented individually or together.

The study methodology for carbon prices primarily consists of quantitative approaches such as DID, PSM-DID, computable general equilibrium (CGE) models, and input-output models. Nevertheless, it is essential to acknowledge that the current body of literature primarily relies on established methodologies and ideas to statistically examine the impact of carbon prices. However, there is a relative scarcity of research focused on understanding the fundamental nature of this phenomena.

5. Emerging Theme Analysis of the Multiple Effects of Carbon Prices

5.1 Theme I: Economic Effects of Carbon Prices

Based on the current research literature, scholars believe that a positive and negative correlation exists between the influences of carbon prices on economic performance. According to the classic hypothesis theory, it is believed that there is a negative association between carbon costs

and economic growth. Zhang et al. (2018) contended that China's underdeveloped carbon market mechanism leads to varying effects of carbon price on the value of energy companies listed in different carbon trading pilot regions. Furthermore, they found that the carbon price has a notable adverse impact on the stock value of these companies. Krokida et al. (2020) emphasized that a rise in the cost of CO_2 emission allowances will adversely affect overall stock returns in European stock markets.

According to Porter's hypothesis, empirical investigations confirm a positive correlation between carbon prices and economic growth. Following research conducted by Bolton et al.(2023) , the correlation between carbon prices and stock prices is primarily contingent upon the percentage of emissions subject to carbon permits. Companies experiencing a severe deficit in carbon allowances observe a favourable correlation between an increase in the daily carbon price and a reduction in their stock price over the same period. Companies with more extensive permit coverage experience a positive correlation between an upward shift in the daily carbon price and an increase in their stock price during the corresponding timeframe. According to Chen et al. (2017), implementing carbon prices benefits a company's efficiency and ability to compete in the market. The carbon price mechanism enables enterprises to make optimal operational choices and enhance their overall performance in the manufacturing sector.

Prior research in the literature has discovered that carbon prices substantially impact total factor productivity (TFP). This is supported by Mo et al.(2023) who stated that a carbon emissions trading system with a clear price trend enhances TFP by 0.381. On the other hand, a CPSM (Carbon Price Stabilization Mechanism) carbon emissions trading system without a clear price cap or floor only improves TFP by 0.198. Furthermore, a carbon emissions trading system without a carbon price stabilization mechanism decreases TFP by 0.352.

Researchers contend that lower carbon prices do not have a good effect on economic growth, competitiveness, and emissions reductions. Flachsland et al. (2020) pointed out that the EU ETS introduces a minimum carbon prices norm, a significant institutional innovation. This innovation is crucial in improving political and economic stability and maintaining price stability within the EU ETS.

5.2 Theme II: Environmental Effects of Carbon Prices

Multiple empirical studies have demonstrated that carbon trading prices significantly influence enterprises' decisions to implement measures aimed at reducing carbon emissions; carbon prices facilitate the shift towards a more diverse energy portfolio and the mitigation of carbon emissions, foster the adoption of low-carbon practices, and supports the advancement of sustainable development (Du & Chen, 2021). In the article by Adamolekun (2024), through the analysis of data from 1,591 enterprises across 23 European nations, the authors identified a positive correlation between increased carbon prices and reduced carbon emissions. According to Khurshid et al. (2023), carbon prices can reduce carbon emissions in the area. However, carbon prices are only beneficial in the short term. To achieve long-term sustainability, it is crucial to implement green technical advancements and strict environmental legislation.

Following research conducted by Lin and Jia (2019b), an increase in the price of carbon emissions trading has a substantial impact on encouraging the reduction of carbon emissions. The reduction of sectors and the growth of the free allowance rate are identified as the primary variables that drive the increase in carbon emissions trading price. Bayer and Aklin (2020) despite the EU ETS's low market price, it effectively encourages corporations to decrease their

carbon emissions. Internal carbon prices (ICP) have the potential to decrease carbon intensity significantly (Zhu et al., 2022).

The researchers determined a direct correlation between the carbon trading price and the effectiveness of carbon emission reduction. Specifically, a higher carbon trading price leads to a more pronounced decrease in carbon emissions, while a lower price does not contribute to better environmental performance. In the article by Lin and Jia (2019b), the authors proposed that implementing a lower-priced carbon emissions trading system would weaken the carbon market's capacity to decrease emissions effectively. The carbon price in the Chinese carbon market is insufficient to mitigate emissions effectively. Green (2021) mentioned that the carbon price mitigation effect is constrained, ranging from 0 to 2 per cent annually.

5.3 Theme III: Social Effects of Carbon Prices

Existing research has mostly examined the influence of carbon prices on employment, social fairness, and the allocation of income among individuals regarding the social consequences of carbon prices.

Several scholars contend that elevated carbon prices positively affect employment inside low-carbon manufacturing and thermal power sectors. For example, in the article by Fragkos and Fragkiadakis (2022), implementing a high carbon prices policy in the EU has a rather modest adverse effect on both GDP and consumption. High carbon price in the context of global decarburization stimulates job growth in low-carbon manufacturing and power industries. Zhang and Cross (2020) contend that employment in China's thermal power industry is poised to rise in response to elevated coal costs resulting from carbon policies.

Regarding the effect on individuals' earnings, the majority of research indicates that carbon prices have varying impacts on rural and urban regions and different income brackets. Shang (2023) outlined four primary pathways by which carbon prices impact poverty and inequality: consumption, income, health, and income recycling. Yan and Yang (2021) discovered that affluent households pay a more significant burden of the expenses associated with carbon emissions. Furthermore, they found that introducing carbon prices does not worsen inequality between urban and rural regions or across various income brackets. Steckel et al. (2021) argued that the distributional impacts of carbon prices on low- and middle-income countries are different, considering differences in their economic and administrative systems. Chepeliev et al. (2021) when considering different carbon price scenarios, there is a notable rise in interregional income disparity, whereas intraregional income inequality experiences a significant drop.

In the article by Zhang et al. (2023), the carbon price mechanism has a progressive impact on income distribution and varying effects on the incomes of urban and rural workers. Rural locations witness a more significant reduction in income for individuals with moderate and high incomes, whilst urban areas see a more substantial decrease in income for individuals with low incomes.

5.4 Research Framework for the Multiple Effects of Carbon Prices

Examining the various impacts of carbon prices helps to define the overall nature of research conducted in this field. The framework for researching the multiple effects of carbon price is summarized in Figure 5, based on the econometric analysis of the literature's characteristics and content and the organization of theoretical perspectives and research methods. The research on carbon price's multiple effects begins by examining the theoretical perspectives of

compliance cost theory, Porter's hypothesis theory, and market signalling theory. It then combines these perspectives with quantitative research methods such as DID, PSM-DID, computable general equilibrium, and input-output models. The research primarily focuses on analyzing the EES impacts of carbon prices, as well as other related research topics.

The carbon price multiple effects research framework provides a comprehensive summary of the study, effectively illustrating the present status of research on the subject. Simultaneously, the framework enables the incorporation of all pertinent material, coherent analysis and interpretation, and standardized categorization. Consequently, there has been a significant improvement in the efficiency and uniformity of interpreting literature on the various impacts of carbon prices.

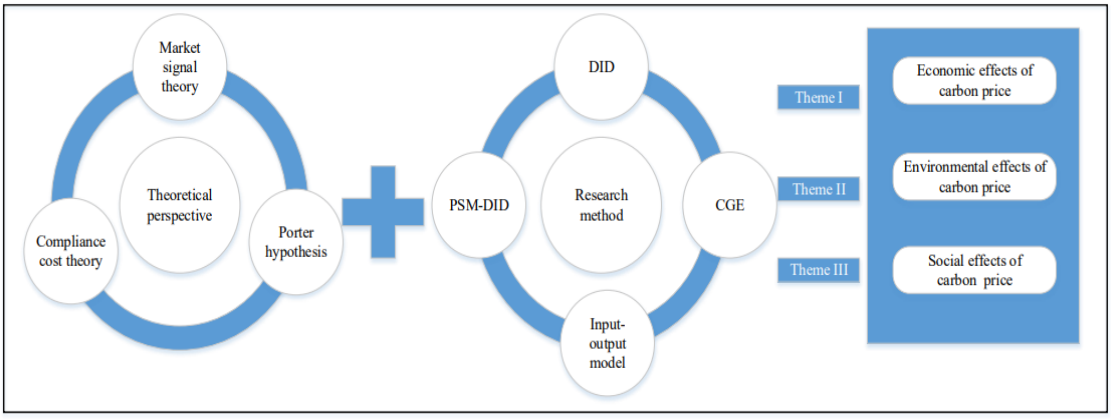

Figure 5: Carbon Price Model

6. Conclusion

This study utilizes a sample of 68 papers from the Web of Science Core Collection and Scopus database from 2000 to 2024. The Cite Space software is employed to display and analyse the knowledge graph. The primary research findings are as follows: a) Current research status. The body of research in the domain of carbon prices is progressively expanding, with a more rapid rate of growth observed after 2021. The literature encompasses a diverse array of periodicals, including prominent worldwide publications such as the Journal of Cleaner Production. These journals delve into several fields such as environmental protection, ecological management, environmental research, and ecology. Scholars have developed several stable author groups, and it is becoming more typical for them to engage in several partnerships. b) Hot research topic. The co-occurrence analysis diagram reveals that the prominent research areas in the field of the various effects of carbon price are emission control, environmental economics, and pollution tax.

c) Research frontier. The keyword emergence mapping study reveals that the forefront of carbon price research mainly focusses on carbon tax, carbon emissions trading, and price dynamics. d) Research Theory. The literature mainly encompasses compliance cost theory, Porter's hypothesis, and market signalling theory. However, there is a dearth of theoretical advancements in emerging environmental settings such as carbon neutrality and carbon peaking. e) Research methods. The literature mostly employs quantitative research approaches, including DID, PSM-DID, computable general equilibrium models, and input-output models.

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References

Adamolekun, G. (2024). Carbon price and firm greenhouse gas emissions. *Journal of Environmental Management*, *349*(September 2023), 119496. https://doi.org/10.1016/j.jenvman.2023.119496

Arrow, K. (2015). What is Neoclassical Economics? In *What is Neoclassical Economics?* https://doi.org/10.4324/9781315659596

Barnett, M., Brock, W., & Hansen, L. P. (2020). Pricing uncertainty induced by climate change. *Review of Financial Studies*, *33*(3), 1024–1066. https://doi.org/10.1093/rfs/hhz144

Bayer, P., & Aklin, M. (2020). The European Union Emissions Trading System reduced CO2 emissions despite low prices. *Proceedings of the National Academy of Sciences of the United States of America*, *117*(16), 8804–8812. https://doi.org/10.1073/pnas.1918128117

Bolton, P., Lam, A., & Muûls, M. (2023). *Do Carbon Prices Affect Stock Prices? **. https://ssrn.com/abstract=4369925

Chen, M., & Wang, K. (2023). The combining and cooperative effects of carbon price and technological innovation on carbon emission reduction: Evidence from China's industrial enterprises. *Journal of Environmental Management*, *343*(May), 118188. https://doi.org/10.1016/j.jenvman.2023.118188

Chen, X., Luo, Z., & Wang, X. (2017). Impact of efficiency, investment, and competition on low carbon manufacturing. *Journal of Cleaner Production*, *143*, 388–400. https://doi.org/10.1016/j.jclepro.2016.12.095

Chepeliev, M., Osorio-Rodarte, I., & van der Mensbrugghe, D. (2021). Distributional impacts of carbon pricing policies under the Paris Agreement: Inter and intra-regional perspectives. *Energy Economics*, *102*(August), 105530. https://doi.org/10.1016/j.eneco.2021.105530

Choi, J. K., Bakshi, B. R., & Haab, T. (2010). Effects of a carbon price in the U.S. on economic sectors, resource use, and emissions: An input-output approach. *Energy Policy*, *38*(7), 3527–3536. https://doi.org/10.1016/j.enpol.2010.02.029

Dong, Y., Lang, X. I., & Wang, T. (2021). Corporate financial performance in the China emission trading scheme: Evidence from China listed firm.

Du, Y., & Chen, S. (2021). *Factors Affecting China ' s Carbon Trading Price — A Case Study Based on Tianjin Carbon Emissions Trading Market*. 1–24.

Flachsland, C., Pahle, M., Burtraw, D., Edenhofer, O., Elkerbout, M., Fischer, C., Tietjen, O., & Zetterberg, L. (2020). How to avoid history repeating itself: the case for an EU Emissions Trading System (EU ETS) price floor revisited. *Climate Policy*, *20*(1), 133–142. https://doi.org/10.1080/14693062.2019.1682494

Fragkos, P., & Fragkiadakis, K. (2022). Analyzing the Macro-Economic and Employment Implications of Ambitious Mitigation Pathways and Carbon Pricing. *Frontiers in Climate*, *4*(April), 1–24. https://doi.org/10.3389/fclim.2022.785136

Green, J. F. (2021). Does carbon pricing reduce emissions? A review of ex-post analyses. *Environmental Research Letters*, *16*(4). https://doi.org/10.1088/1748-9326/abdae9

Ji, C. J., Hu, Y. J., & Tang, B. J. (2018). Research on carbon market price mechanism and influencing factors: a literature review. *Natural Hazards*, *92*(2), 761–782. https://doi.org/10.1007/s11069-018-3223-1

Ji, C. J., Li, X. Y., Hu, Y. J., Wang, X. Y., & Tang, B. J. (2019). Research on carbon price in emissions trading scheme: a bibliometric analysis. *Natural Hazards*, *99*(3), 1381–1396. https://doi.org/10.1007/s11069-018-3433-6

Khurshid, A., Rauf, A., Qayyum, S., Calin, A. C., & Duan, W. Q. (2023). Green innovation and carbon emissions: the role of carbon pricing and environmental policies in attaining sustainable development targets of carbon mitigation—evidence from Central-Eastern Europe. *Environment, Development and Sustainability*, *25*(8), 8777–8798. https://doi.org/10.1007/s10668-022-02422-3

Krokida, S. I., Lambertides, N., Savva, C. S., & Tsouknidis, D. A. (2020). The effects of oil price shocks on the prices of EU emission trading system and European stock returns. *European Journal of Finance*, *26*(1), 1–13. https://doi.org/10.1080/1351847X.2019.1637358

Lin, B., & Jia, Z. (2019a). Impacts of carbon price level in carbon emission trading market. *Applied Energy*, *239*, 157–170. https://doi.org/10.1016/j.apenergy.2019.01.194

Lin, B., & Jia, Z. (2019b). What are the main factors affecting carbon price in Emission Trading Scheme? A case study in China. *Science of the Total Environment*, *654*, 525–534. https://doi.org/10.1016/j.scitotenv.2018.11.106

Maestre-Andrés, S., Drews, S., & van den Bergh, J. (2019). Perceived fairness and public acceptability of carbon pricing: a review of the literature. *Climate Policy*, *19*(9), 1186–1204. https://doi.org/10.1080/14693062.2019.1639490

Mehling, M., & Tvinnereim, E. (2018). Carbon Pricing and the 1.5°C Target: Near-Term Decarbonisation and the Importance of an Instrument Mix. *Carbon & Climate Law Review*, *12*(1), 50–61. https://doi.org/10.21552/cclr/2018/1/9

Mo, J., Tu, Q., & Wang, J. (2023). Carbon pricing and enterprise productivity-The role of price stabilization mechanism. *Energy Economics*, *120*. https://doi.org/10.1016/j.eneco.2023.106631

Morris, R. D. (1987). Signalling, Agency Theory and Accounting Policy Choice. *Accounting and Business Research*, *18*(69), 47–56. https://doi.org/10.1080/00014788.1987.9729347

Narassimhan, E., Gallagher, K. S., Koester, S., & Rivera Alejo, J. (2017). Carbon Pricing In Practice : A Review of the Evidence. *Climate Policy Lab*, *July*, 50. https://sites.tufts.edu/cierp/files/2017/11/Carbon-Pricing-In-Practice-A-Review-of-the-Evidence.pdf

Porter, M. E., & Van Der Linde, C. (1995). Toward a New Conception of the Environment-Competitiveness Relationship. In *Journal of Economic Perspectives* (Vol. 9, Issue 4).

Shang, B. (2023). The Poverty and Distributional Impacts of Carbon Pricing: Channels and Policy Implications. *Review of Environmental Economics and Policy*, *17*(1), 64–85. https://doi.org/10.1086/723899

SPENCE, M. (1978). JOB MARKET SIGNALING **The essay is based on the author's doctoral dissertation ("Market Signalling: The Informational Structure of Job Markets and Related Phenomena," Ph.D. thesis, Harvard University, 1972), forthcoming as a book entitled Market Signalin. In *Uncertainty in Economics* (Vol. 87). ACADEMIC PRESS, INC. https://doi.org/10.1016/b978-0-12-214850-7.50025-5

Steckel, J. C., Renner, S., & Missbach, L. (2021). Distributional Impacts of Carbon Pricing in Low and Middle-Income Countries. *CESifo Forum*, *22*(5), 26–32.

Thube, S., Peterson, S., Nachtigall, D., & Ellis, J. (2021). The economic and environment benefits from international co-ordination on carbon pricing: A review of economic modelling studies. *Environmental Research Letters*, *16*(11). https://doi.org/10.1088/1748-9326/ac2b61

Wu, Q. (2022). Price and scale effects of China's carbon emission trading system pilots on emission reduction. *Journal of Environmental Management*, *314*(February), 115054. https://doi.org/10.1016/j.jenvman.2022.115054

Wu, Q., & Wang, Y. (2022). How does carbon emission price stimulate enterprises' total factor productivity? Insights from China's emission trading scheme pilots. *Energy Economics*, *109*. https://doi.org/10.1016/j.eneco.2022.105990

Yan, J., & Yang, J. (2021). Carbon pricing and income inequality:A case study of Guangdong Province, China. *Journal of Cleaner Production*, *296*, 126491. https://doi.org/10.1016/j.jclepro.2021.126491

Ye, H. (2022). Literature review and research prospect prediction of carbon emission trading market. *Financial Engineering and Risk Management*, *5*(5), 84–88. https://doi.org/10.23977/ferm.2022.050511

Zhang, F., Fang, H., & Wang, X. (2018). Impact of carbon prices on corporate value: The case of China's thermal listed enterprises. *Sustainability (Switzerland)*, *10*(9). https://doi.org/10.3390/su10093328

Zhang, J., & Cross, M. L. (2020). Carbon policies, fossil fuel price, and the impact on employment. *Clean Technologies and Environmental Policy*, *22*(5), 1085–1095. https://doi.org/10.1007/s10098-020-01850-x

Zhang, Y., Jiang, S., Lin, X., Qi, L., & Sharp, B. (2023). Income distribution effect of carbon pricing mechanism under China's carbon peak target: CGE-based assessments. *Environmental Impact Assessment Review*, *101*(April), 107149. https://doi.org/10.1016/j.eiar.2023.107149

Zhao, Y., Wang, C., & Cai, W. (2022). Carbon pricing policy, revenue recycling schemes, and income inequality: A multi-regional dynamic CGE assessment for China. *Resources, Conservation and Recycling*, *181*(November 2021), 106246. https://doi.org/10.1016/j.resconrec.2022.106246

Zhu, B., Ye, S., Wang, P., Chevallier, J., & Wei, Y. M. (2022). Forecasting carbon price using a multi-objective least squares support vector machine with mixture kernels. *Journal of Forecasting*, *41*(1), 100–117. https://doi.org/10.1002/for.2784

Zhu, J., Fan, Y., Deng, X., & Xue, L. (2019). Low-carbon innovation induced by emissions trading in China. *Nature Communications*, *10*(1). https://doi.org/10.1038/s41467-019-12213-6