A Literature Review of the Impact of Multidimensional Relationship Networks on Corporate Carbon Emission Reduction

Bo Zhao[1,a], Li Lu[2,b], Xiaojuan Luo[2,*]

[1]Regional Development Research Institute, Jiangxi Normal University, Nanchang 330022, China
[2]Jiangxi Economic Development Research Institute, Jiangxi Normal University, Nanchang 330022, China

[a]306117656@qq.com, [b]lvlsha@163.com, *lxj918@126.com

Abstract. The report of the 20th Party Congress clearly puts forward the requirements of synergistically promoting carbon reduction, pollution reduction, green expansion and growth, and promoting ecological priority, conservation and intensification, and green and low-carbon development. In this context, this paper studies the impact of multidimensional relationship network on carbon emission reduction of industrial enterprises, which is of great strategic significance to promote the development of industrial sector and enterprises themselves. The main conclusions of this paper are as follows: first, the multidimensional relationship network has a significant role in promoting carbon emission reduction of enterprises; second, the research on multidimensional relationship network and carbon emission reduction will continue to receive extensive attention in the academic world. Finally, on the basis of the existing literature, this paper points out the future research outlook from the environmental, micro and spatial levels.

Keywords: Multidimensional relational network; carbon emission reduction; Dual carbon targets; industrial enterprises.

1 Introduction

Against the backdrop of global warming and the international community's efforts to slow down carbon dioxide emissions, China is facing enormous pressure to reduce carbon dioxide emissions. In 2023, global energy-related carbon dioxide emissions reached a record high of 37.4 billion tons. China's carbon emissions increased by about 565 million tons, of which coal emissions accounted for more than 65% of the growth emissions, has become the world's largest CO2 emitter. As an active participant and supporter of global climate governance, China made a commitment at the 75th General Debate of the United Nations General Assembly to peak carbon emissions by 2030 and achieve carbon neutrality by 2060. As the world's largest industrialized country, China is under tremendous pressure to reduce emissions.

Q. Wu et al. (eds.), *Proceedings of the 2024 3rd International Conference on Public Service, Economic Management and Sustainable Development (PESD 2024)*, Advances in Economics, Business and Management Research 309,
https://doi.org/10.2991/978-94-6463-598-0_48

As a matter of fact, relationship network can provide enterprises with external support such as information, capital, personnel and emotion, etc. Rapidly embedding relationship network becomes a breakthrough for enterprises to obtain the safe haven effect and form emission reduction capital. The relationship network helps to form common social norms to restrain opportunistic behaviors, and to form regulatory mechanisms to prevent opportunistic and fraudulent behaviors, thus reducing the cost of environmental governance and promoting the orderly operation of corporate pollution emissions in accordance with established norms and market rules. Therefore, clarifying the driving mechanism and boosting effect of social networks on the environmental impacts of enterprises has become a core issue that needs to be solved urgently.

Industrial enterprises, as one of the main bodies of environmental governance and carbon emission reduction, how to achieve efficiency growth at the same time, carbon emissions are also better controlled, this dilemma has become an important issue in front of the development of industrial enterprises. In this context, the study of the impact of multidimensional relationship networks on carbon emission reduction in industrial enterprises is of strategic significance for promoting the development of the industrial sector and enterprises themselves.

2 Definition of Basic Concepts

2.1 Multidimensional Relational Networks

A relational network is a collection of actors and their interrelationships, and from the point of view of its formalization, the network is represented by points and lines, which can be seen as a collection of points formed between social actors and their relationship lines between points. With scholars' in-depth study of relational networks, the object of relational network research has been extended from the most basic behavior of individuals to group organizations, and the level of analysis has been expanded from the level of individual behavior to the level of business organizations. The concept of relational networks at the enterprise level is divided into two kinds: the first is based on the resource view[1], which mainly refers to the collection of apparent and potential resources embedded in the network structure of the enterprise that can be controlled by the enterprise, and that are conducive to the enterprise's realization of its goals and activities to achieve its goals; and the second is based on the capability view[2], which mainly refers to the interactions involving interactions with the enterprise and the external environment and the ability to obtain the required resources through these interactions.

2.2 Carbon Emission Intensity of Enterprises

Carbon emission intensity refers to the amount of carbon dioxide emissions per unit of Gross Domestic Product (GDP), and this indicator can more accurately reflect the concept of low-carbon economic development. It is mainly used to assess the link between a country's economic development and carbon emissions. At the micro level,

researchers usually measure this intensity by dividing a firm's CO2 emissions by its business revenue. Where CO2 emissions usually refers to the total amount of all greenhouse gases emitted or the acronym. The Chinese government decided at its executive meeting on November 25, 2009, that by 2020, China's carbon dioxide emissions per unit of GDP will be reduced by 40% to 45% compared to 2005, and incorporated this goal as a binding target in the long-term plan for national economic and social development, while formulating corresponding statistics, monitoring and assessment methods. This is the first time that China has put forward a specific quantitative target for CO2 emission reduction, and it is also the first of the world's major countries to combine carbon emission reduction with GDP. Carbon intensity is calculated by dividing carbon dioxide emissions by GDP, a ratio that represents the amount of carbon dioxide emissions per unit of GDP, and is a key indicator of energy efficiency and carbon dioxide emission efficiency in China's economic growth process. Typically, carbon emission intensity is gradually reduced as technological progress and the level of economic development increase.

3 Multidimensional Relationship Network and the Measurement System of Carbon Emissions

3.1 Measurement of Multidimensional Relationship Network

On the basis of the research on the concept of social capital, scholars at home and abroad pay attention to the portrayal of social capital dimensions at the same time. According to different cultural backgrounds, there are two main types of measurement of relationship networks. One type is based on the portrayal under the conditions of foreign market economy and cultural background. The most representative is Granovetter (1995)[3] who proposed structural embeddedness dimension (relational network) and relational embeddedness dimension (types of interpersonal relationships, such as respect, friendship, etc.). As well as on this basis, the multidimensional approach to categorization is represented by the study of Nahapiet and Ghoshal, who structured the concept of social capital in terms of structural, relational, and cognitive dimensions, which are expressed in terms of the density, size, and composition of interpersonal networks (structural dimensions), beliefs, norms, obligations, and expectations (relational dimensions), and shared linguistic-cognitive systems (cognitive dimensions), etc. Wang et al. (2023)[4] used political relations as a relational network for firms, arguing that firms, by establishing good governmental relations, can effectively expand investment opportunities and reduce the costs of obtaining information and conducting transactions in investment decisions, thus improving investment efficiency.

In the other category, Chinese scholars classify relationship network dimensions based on Chinese cultural background. According to the number of dimensions, they can be categorized as one-dimensional, two-dimensional and multi-dimensional. The one-dimensional categorization usually equates business relationships with trust. Scholars usually measure social networks in terms of the dimension of the entrepre-

neur's work background. The two-dimensional classification approach includes structural and cognitive dimensions. Some scholars believe that the structural dimension is mainly manifested in objective and specific organizations and networks, and the cognitive dimension is manifested in the level of trust, which is relatively subjective and difficult to touch. On this basis, Zeng et al. (2000)[5] enriched and deepened the connotation of its dimensions and expanded the content of social relational capital by defining it as the connection with higher leadership organs, political organizations, local government departments, and various intermediary organizations and financial organizations, and this social relational capital is for obtaining the resources from the various organizations.Li et al. (2024)[6] took the market relationship, supplier relationship and customer relationship, the more multidimensional relationship network of the enterprise indicates that the enterprise has more opportunities in information dissemination, resource transfer and enterprise cooperation, and thus has a higher status and influence in the network.

3.2 Measurement of Carbon Emissions

China is a large country in terms of energy use and carbon emissions, but the existing statistics do not have direct statistics on CO2 emissions by region and industry, and the existing literature calculates regional carbon emissions mainly by counting the amount of energy used by various types of energy and then measuring CO2 emissions through specific calculations. Zhang (2000)[7] was the first to analyze the carbon emission factors by using the logarithmic difference method, and he concluded that China's carbon emissions during 1980-1997 were 50% lower than the theoretical emissions, indicating that China began to reduce its carbon emissions through policy and technological means in the 1980s; Jiang et al.(2024)[8] conducted practical tests using a portable emission measurement system (PEMS), analyzed the complex nonlinear relationship between climatic conditions and carbon dioxide emissions using the random forest (RF) algorithm, and compared with the COPERT model, and found that the RF model demonstrated high accuracy in predicting carbon emissions; Yu et al. (2024)[9] measured the carbon emissions of 31 provincial regions across the country between 2001 and 2020 using the life cycle assessment (LCA) method from the industrial chain perspective, used the life cycle assessment (LCA) method to measure the carbon emissions of 31 provincial regions in China from 2001 to 2020, and utilized the logarithmic mean divergence index (LMDI) model to classify the factors affecting carbon emissions at the national level, in each province, and at each production stage.

4 The Influence of Multidimensional Relationship Network on Enterprise Carbon Emission Reduction

Researchers at home and abroad generally agree that multidimensional relationship networks play a crucial role in the impact of carbon emissions, however, there are two diametrically opposed conclusions about the specific manifestations of this impact.

4.1 Multidimensional Relationship Network Reduces Carbon Emissions

Most scholars believe that relational networks can theoretically have an inhibitory effect on carbon emissions through technological development, research and development of technologies to improve carbon emissions, thereby reducing carbon emissions and improving the quality of the environment. Chen et al. (2020)[10] examined the impact of relational networks on regional carbon emissions by establishing a panel model and a panel quartile model for 36 OECD member countries for the period 1970-2016, and found that relational networks can reduce carbon emissions and improve environmental quality. and found that relational networks can reduce the growth of regional carbon dioxide; Zhou and Liu (2021)[11] combined the research data of 2703 enterprises and constructed an econometric model using hierarchical analysis to explore the impact of relational network embeddedness on the carbon emission reduction behaviors of enterprises, and found that governmental embeddedness, market embeddedness, and industry embeddedness help to incentivize the carbon emission reduction behaviors of enterprises; Using provincial panel data on China's carbon dioxide emissions from 1997 to 2008 and applying generalized least squares estimation to analyze the role of relational networks on carbon emissions, Zhang and Lu(2023)[12] show that the relational networks formed by the interaction between the public and enterprises help to reduce carbon emissions and carbon emissions strong; Okimoto and Takaoka (2024)[13] take Japanese enterprises as the object of their study, and find that the industry network of the enterprise has a significant diminishing effect on the carbon emissions, in addition to that, the market network of the enterprise is also the most important factor affecting carbon emissions.

4.2 Multi-Dimensional Relationship Networks Increase Carbon Emissions

However, some scholars have found that despite the relevance of multidimensional relationship networks, the process of constructing multidimensional relationship networks is usually accompanied by increased energy consumption, economic growth and technological advances, which may harm environmental quality and have a contributing effect on carbon emissions. Wang et al.(2023)[4] based on the panel data of China's industrial enterprises in the period of 2008-2020, used a dynamic GMM approach to study the relationship between corporate political relationship network and carbon emissions of industrial enterprises, and found that the political relationship network of enterprises has a promoting effect on carbon emissions; Xie et al. (2023)[14] studied the relationship between corporate political relationships and pollution emissions using data from 689 listed companies in China from 1999-2010, and the study showed that political relationships increase pollution emissions of enterprises.

4.3 The Spatial Impact of Multidimensional Relationship Networks on Carbon Emissions

With the depth of research, scholars have found that multidimensional relationship networks have spatial characteristics on carbon emissions. Through the construction of relationship networks each enterprise can share advanced carbon emission reduction technology and management methods, and promote the dissemination and exchange of carbon emission reduction technology and management experience. Holtkamp and Weaver (2018)[15], utilized visualization to illustrate the distributional differences of relational networks at the regional or national level, but lacked in-depth discussion on the dynamics of the spatial attributes of social networks; Jiang et al. (2024)[16] examined the impacts of governmental networks and their spatial spillovers in the Central and Eastern European region by using city-level panel data in China, and the results showed that governmental networks significantly improved local CEE carbon emissions, however, government networks produced negative spatial spillover effects and reduced CEE carbon emissions in neighboring cities.

5 Conclusions

Since the 1930s, some scholars represented by Brass have put forward the theory of relational networks, and the relationship between relational networks and carbon emissions has been widely discussed in the theoretical community. After combing a large amount of literature at home and abroad, the following two main conclusions are obtained.

First, multidimensional relational networks have significant positive effects on corporate carbon emission reduction. While most of the previous literature explains the driving factors of carbon emission reduction from the perspectives of internal characteristics of enterprises, such as enterprise scale, nature of ownership, and quality of enterprise managers, a large number of theoretical researches and practical experiences have shown that the multidimensional relationship network is an important source for enterprises to obtain resources, and at the same time, it has also become an important factor for enterprises to realize carbon emission reduction, and considers that multi-dimensional relationship network is an important choice for the improvement of enterprise emission reduction ability.

Secondly, the research on multi-dimensional relationship network and carbon emission reduction will remain a hot issue in the academic world for a long time in the future, and with the in-depth implementation of the “dual-carbon” policy in the country, this heat will be further elevated compared with the current situation. Experts and scholars in the study of multidimensional relational networks and carbon emission reduction have harvested fruitful results, attracting a large number of well-known scholars and national major scientific research projects to participate in, and has achieved the following achievements: explored the connotation and characteristics of relational network theory and other basic research, supplemented the quantitative research methodology, the use of econometric modeling, databases, etc., on the meas-

urement and analysis of multidimensional relational networks and carbon emissions. analyze.

Acknowledgment

This research is supported by National Natural Science Foundation of China [grant number 72063019]; Jiangxi Province Social Science Planning Foundation, [grant number 22YJ14]; Jiangxi Province Cultural and Artistic Science Planning Foundation [grant number YG2022154].

References

1. Brass, D.J., Galaskiewicz, J., Greve, H.R., Tsai, W., 2004. Taking Stock of Networks and Organizations: A Multilevel Perspective. Acad. Manage. J. 47, 795–817. https://doi.org/10.2307/20159624.
2. Chen, Xiaobei, Chen, Xueting, 2021. Media Pressure, Financing Constraints, and Industrial Enterprises' Carbon Emissions——Based on Regulating Effect of Green Invention Patent. Sci Technol. Prog. Policy. 38, 69–78. https://doi.org/10.6049/kjjbydc.2020060332.
3. Granovetter, M., 1995. Coase Revisited: Business Groups in the Modern Economy. Industrial and Corporate Change 4, 93–130. https://doi.org/10.21789/24222704.1745.
4. Holtkamp, C.R., Weaver, R.C., 2018. Quantifying the relationship between social capital and economic conditions in Appalachia. Appl. Geogr. 90, 175–186. https://doi.org/10.1016/j.apgeog.2017.12.010.
5. Jiang, H., Hu, W., Guo, Z., Hou, Y., Chen, T., 2024. E-commerce development and carbon emission efficiency: Evidence from 240 cities in China. Economic Analysis and Policy 82, 586–603. https://doi.org/10.1016/j.eap.2024.04.009.
6. Jiang, Z., Wu, L., Niu, H., Jia, Z., Qi, Z., Liu, Y., Zhang, Q., Wang, T., Peng, J., Mao, H., 2024. Investigating the impact of high-altitude on vehicle carbon emissions: A comprehensive on-road driving study. Sci. Total Environ. 918. https://doi.org/10.1016/j.scitotenv.2024.170671.
7. Li, J., Li, S., Zhang, Y., Tang, X., 2024. Network evolutionary game analysis of green credit: A perspective of carbon emissions trading. Manag. Decis. Econ. 45, 1343–1362. https://doi.org/10.1002/mde.4064.
8. Okimoto, T., Takaoka, S., 2024. Credit default swaps and corporate carbon emissions in Japan. Energy Econ. 133, 107504-. https://doi.org/10.1016/j.eneco.2024.107504.
9. Wang, Z., Fu, H., Ren, X., 2023. Political connections and corporate carbon emission: New evidence from Chinese industrial firms. Technol. Forecast. Soc. Chang. 188, 122326. https://doi.org/10.1016/j.techfore.2023.122326.
10. Woolcock, M., 2001. Microenterprise and social capital: J. Socio-Econ. 30, 193–198. https://doi.org/10.1016/S1053-5357(00)00106-2.
11. Xie, R., Zhang, J., Tang, C., 2023. Political connection and water pollution: New evidence from Chinese listed firms. Resour. Energy Econ. 74, 101390. https://doi.org/10.1016/j.reseneeco.2023.101390.
12. Yu, Y., Li, Q., Bao, Y., Fu, E., Chen, Y., Ni, T., 2024. Research on the Measurement and Influencing Factors of Carbon Emissions in the Swine Industry from the Perspective of the Industry Chain. Sustainability 16, 2199-. https://doi.org/10.3390/su16052199.

13. Zeng, S., Xie, X., Tam, C.M., 2010. Relationship between cooperation networks and innovation performance of SMEs. Technovation 30, 181–194. https://doi.org/10.1016/j.technovation.2009.08.003.
14. Zhang, Y., Lu, X., 2011. Public Participating in Management and China Reduction Action: An Empirical Analysis Based on the Provincial Panel Data. Chin. J. Popul. Sci. 64-72,112.
15. Zhang, Z., 2000. Decoupling China's Carbon Emissions Increase from Economic Growth: An Economic Analysis and Policy Implications. World Development 28, 739–752. https://doi.org/10.3390/en9110921.
16. Zhou, J., Liu, Y., 2021. Institutional Embeddedness, Green Technology Innovation and Carbon Emission Reduction of New Ventures. Popul. Resour. Environ. 31, 90–101. https://doi.org/10.12062 /cpre.20201214.