

Study on Supply Chain Carbon Emission Reduction Measures

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Abstract: A comparative study of three carbon reduction measures in the supply chain, namely carbon tax, government subsidies and carbon trading, is conducted to analyse their advantages and disadvantages, the level of emission reduction and the impacts on supply chain members. Further, through real-life supply chain scenarios such as manufacturing and new energy vehicles, we focus on analysing the emission reduction effects of different government subsidies for manufacturers and retailers. The results show that carbon tax is advantageous in driving economic growth. Different government subsidies stimulate consumption leading to profit growth. The carbon market is easier to implement and control but is still in its infancy and needs to be supported by relevant policies. Manufacturers and retailers in different industrial supply chains have different preferences when it comes to different subsidies, and the right subsidies can lead to higher social welfare and economic efficiency.

Keywords: Component; Supply Chain; Carbon Reduction; Carbon Tax; Government Subsidy; Carbon Trading.

1. Introduction

The global ecological environment is deteriorating and the greenhouse effect phenomenon is becoming more and more serious, how to reduce carbon dioxide emissions is a common concern of all mankind. The government has introduced a series of policies and regulations to reduce carbon emissions, and utilised carbon policies to promote the green transformation of enterprises and the improvement of the ecological environment. Scholars at home and abroad have studied and explored different emission reduction policies. Regarding carbon tax, Yanju Zhou conducted a comparative study on the respective optimal decisions of the government, manufacturers and retailers in the retail market under the two scenarios of monopoly and competition, showing that the implementation of the optimal carbon tax rate is favourable for improving social welfare [1]. Wang Jun et al. found that carbon tax level and initial reference carbon emissions have an impact on both pricing and emission reduction strategies of supply chain members [2]. On government subsidies, Zhao Jinghua et al. explore the effects of different targets of government subsidies on channel members' pricing decisions and profits, and find that different targets of government subsidies bring different subsidy effects [3]. Jiang Jiayou et al. found that the level of retailer CSR implementation is positively proportional to the earnings of supply chain firms, in addition, the government implements subsidies to both increase the earnings of supply chain firms and make the effect of emission reduction more explicit [4]. In terms of carbon trading, Perdan et al. show that the integration and coordination of carbon trading schemes around the world requires the support of information technology and the government's strengthening of market supervision to ensure a stable environment for the implementation of carbon trading [5]. Yu et al. proposed that China should further improve the carbon market construction, strengthen cross-regional cooperation, encourage enterprises to actively participate in the carbon trading market, and establish a perfect national carbon trading market [6].

At present, most of the research is aimed at one or two

carbon emission reduction measures in-depth research, in view of this, this paper is a comparative analysis of three of these policies, to study the advantages and disadvantages of each and the effect of the level of emission reduction on the supply chain. Further, through actual supply chain scenarios such as manufacturing and new energy vehicles, we study the emission reduction effects and profits of individual manufacturers and individual retailers under multiple subsidies.

2. Comparative Analysis of Carbon Reduction Measures

Upon examination, the carbon tax policy has the following two advantages. Economically, a carbon tax can promote economic growth. Carbon tax revenue is a new kind of fiscal revenue, it will allow government departments to have more money to support the transformation of enterprises, which has a positive significance for the vigorous development of the economy, and also has room to slow down the taxation of other taxes, which is conducive to the high-quality development of the economy. From the social level, the carbon tax promotes the rise of fossil energy prices and the decline of clean energy prices, which in turn prompts enterprises to adopt energy substitution, technology investment and innovation and other means to significantly reduce carbon dioxide emissions, long-term ecological balance, and create long-term benefits for human society. However, the carbon tax policy has its shortcomings: carbon tax will raise the price of energy-related products, impact on the development of energy-intensive industries, inhibit residents' consumption demand, investment demand, and have a negative impact on the development of the national economy. But this is not a long-term impact on the industry and the region, but in the long term the introduction of carbon tax has a positive effect on the growth of the national economy, the negative impact of carbon tax will be transformed into a positive impact in a fairly long period of time, and vigorously promote high-quality development, reduce carbon dioxide emissions, and effectively reduce environmental pollution and protection of ecological resources

[7].

Government subsidy policies can guide and regulate the emission reduction behaviour of enterprises and mobilise them to actively participate in technological research and development to reduce emissions. Whether or not the government subsidises manufacturers' emission reduction inputs and manufacturers' product outputs, it is conducive to promoting the improvement of manufacturers' emission reduction levels, and both subsidy scenarios can increase corporate profits and social welfare. There should be different types of subsidies for different stages of emission reduction, but whatever subsidies are used by the government will lead to an increase in social welfare [8]. However, government subsidies may make the development of enterprises overly dependent on government policy support and financial subsidies, which may result in their low competitiveness and be detrimental to their long-term development. Over-reliance can have a negative impact on the sustained operation of enterprises.

Carbon trading, as an effective means of market regulation has three major advantages. First, carbon trading emission reduction effectiveness certainty. The total amount of carbon emission quotas is directly determined by the government over a period of time, so the results of emission reduction are more intuitive and clearer, without the need for other intermediate variables to pass. Second, in addition to regular quota trading, the carbon emissions trading market can carry out trading of quota futures, options and other derivatives to further enhance market efficiency. Promote cross-border emission reduction coordination. Different carbon emissions trading markets can be interconnected to form a cross-border and cross-regional carbon emissions trading market. Compared with carbon tax, carbon trading is more convenient. However, the coverage of China's carbon trading market is still incomplete and still in the initial stage, it is difficult to completely solve the different situations faced by various regions with a unified carbon trading market, and there are problems such as low information transparency, unsound price system and insufficient market liquidity, etc., it is difficult to effectively regulate the carbon emission behaviours of various regions relying only on the carbon market. Government policy support is needed, and government subsidies for emission reduction enterprises are an important incentive to promote China's low-carbon market economy, and different subsidies can be chosen according to the level of difficulty of emission reduction in order to obtain a higher level of social welfare.

3. Study on Government Subsidy Strategy

There are two modes of government subsidies in the new energy vehicle supply chain. First, in the case of direct government subsidies to manufacturers, manufacturers and sellers will stimulate consumer purchasing behaviour by lowering both wholesale prices and sales prices to boost the sales volume of new energy vehicles in the face of increased government subsidies. Second, in the case of direct government subsidies to sellers, manufacturers indirectly share a portion of the government subsidy by increasing wholesale prices, which drives sellers to lower sales prices, while increased sales compensate for lost profits. This suggests that the automotive supply chain as a whole is dominated by manufacturers, which have more bargaining power than sellers. Subsidising manufacturers is more

conducive to the sustainable development of new energy vehicles [9]. It can be seen that the two types of government subsidies do not have a differential impact on the profitability of the automotive supply chain and strongly promote the progress of R&D of new energy vehicles.

There are two types of government subsidies in the pharmaceutical manufacturing industry: greenness subsidies and subsidies for green R&D and innovation costs. First, greenness subsidies are government subsidies to manufacturers based on the greenness of their products, which help to increase their economic returns and provide incentives for them to develop and produce green products, to make green products, and to take the initiative to assume and improve their social responsibility. For retailers, even if the government does not subsidise them and they are not socially responsible, their economic returns will still increase with the increase in government subsidies and the increase in the level of social responsibility of the manufacturers, which creates the phenomenon of "free-riding" by retailers, and also indicates the possibility of cooperation among supply chain members. Second, green R&D and innovation cost subsidies are an effective way to promote the enthusiasm of manufacturers [10]. When the government gives manufacturers subsidies for green R&D and innovation costs, the greenness of their products, retail prices, market demand and consumer surplus all increase with the intensity of government subsidies. Both the retailer's economic returns and the manufacturer's overall returns increase with the intensity of the government subsidy, but the increase in the retailer's economic returns is not as prominent as the manufacturer's returns, which also leads to higher retail prices [11].

Comparing the two types of subsidies, the greenness subsidy is preferred by manufacturers and the greenness subsidy mechanism is more favourable to increase the economic and overall benefits of manufacturers. Retailers have a higher preference for green R&D and innovation subsidies, and green R&D and innovation cost subsidies are more socially beneficial for the same amount of government spending, which means that the government prefers the green R&D and innovation cost subsidy mechanism.

4. Conclusion

(1) The carbon tax policy has the advantage of promoting economic growth, etc., and it will have a negative impact on the economy in the short term, but will turn into a positive impact in the long term. Government subsidies will help mobilise manufacturers and retailers and promote higher levels of emissions reductions, corporate profits and social welfare, but companies will become overly reliant on them. Carbon trading measures are easier to implement and yield higher social benefits, but are still in their infancy and have drawbacks such as inadequate systems and difficulties in regulating them on their own.

(2) In the supply chain of new energy vehicles, subsidies for both manufacturers and sellers can promote increased sales and profits, with no discriminatory impact, and are conducive to sustainable development. In the pharmaceutical manufacturing industry, manufacturers are suitable for green subsidies, which can increase the economic efficiency and motivation of manufacturers. Retailers are suitable for green R&D and innovation subsidies, with higher social benefits for the same government expenditure.

In addition, this paper has only conducted a shallow comparison of the three carbon abatement measures, and more

comparative analyses can be extended in future studies. This paper has only considered real supply chain scenarios such as new energy vehicles and pharmaceutical manufacturing, where a single manufacturer and a single retailer are subject to different subsidy policies, while the market contains multiple retailers and manufacturers as well as other supply chain members, and the multiple supply chain member effect can be considered in future research and subsequent studies.

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References

- [1] Yanju Zhou, Fengying Hu, Zhenglong Zhou & Xiongwei Zhou. (2017). Impact of optimal carbon tax rate on supply chain structure and social welfare. *Systems Engineering Theory and Practice* (04), 886-900.
- [2] Jun Wang, Xianxue Cheng, Yushan Jiang & Zhenmin Dong. 2011 A new species of the genus *Pterocarpus* (Coleoptera, Staphylinidae, Pterocarpini) from China. (2021). A study on supply chain members' behavioural choices considering reference carbon emissions under carbon tax policy. *China Management Science* (07), 128138.
- [3] Zhao, Jinghua & Lin, J. (2017). A closed-loop supply chain pricing model with different subsidy targets. *Journal of Management Engineering* (01), 85-92.
- [4] Jiang, J. X., He, X. X. & Hu, W.-F. (2022). A three-tier supply chain emission reduction strategy considering carbon subsidies and corporate social responsibility. *Systems Engineering* (01), 97-106.
- [5] Slobodan Perdan & Adisa Azapagic. (2011). Carbon trading: Current schemes and future developments. *Energy Policy* (10). doi:10. 1016/j.enpol.2011.07.003.
- [6] Yu, P. & Liu, J.-H. (2020). Research on the green and economic growth effects of carbon trading market size. *China Soft Science* (04), 46-55.
- [7] Zhang, Deng. (2022). Exploration of China's Carbon Tax System under the Goal of "Dual Carbon" (Master's thesis, China Academy of Financial Sciences). <https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CMFD202202&filename=1022537732.nh>
- [8] Cao, Xueying. (2021). Research on Supply Chain Emission Reduction Subsidy Strategy in Carbon Trading Environment (Master's thesis, Guangxi University of Science and Technology). <https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CMFD202301&filename=1021770473.nh>
- [9] Li, Linzhi. (2019). Research on Pricing and Subsidy Strategies of Automotive Supply Chain in New Energy Context (Master's thesis, Chongqing Jiaotong University). <https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CMFD202001&filename=1019073241.nh>
- [10] Jiang, S. Y. & Fang, P. Q. (2019). Research on the effect of government subsidy based on green supply chain. *Journal of Systems Management* (03), 594-600.
- [11] Feng Ying, Wang Mengyuan, Zhang Yanzhi & Feng Chunhua. (2022). A government subsidy mechanism for green supply chain with manufacturer's social responsibility. *Journal of Management Engineering* (06), 156-167.