

Establishing and Analyzing Commercial Banks' Carbon Finance Business Revenue Model

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[Abstract] We developed this study based on a summary of current studies on development of the carbon finance business by commercial banks. To determine the amount of carbon emissions and production cost incurred by enterprises, we analyzed emission reduction equipment and carbon emission rights purchased by emission reduction enterprises. Next, to establish a revenue model for commercial banks' carbon finance business, we analyzed and compared the revenue and the revenue impacting factors and identified theoretical conditions under which commercial banks may develop carbon finance business.

[Keywords] commercial banks, carbon finance, carbon emission, revenue model

Introduction

Global warming has become one of the key issues of interest in countries around the world. Based on the pressure to reduce carbon emissions and characteristics of its development, the use of financial market tools to achieve the goal of reducing carbon emission has both theoretical implications and practical value. Internationally, carbon emission resources, carbon trading, and carbon derivatives trading have great development potential and create commercial opportunities. The "carbon finance" derived from the above situation is an important method not only for realizing energy savings and emission reduction but also for achieving low-carbon development in the environmental finance area, which is a "hot" research topic. As primary financial institutions, commercial banks actively participating in carbon emission innovation should have two objectives: realizing carbon emission reduction and increasing enterprises' operating revenue.

"Carbon finance" remains at the theoretical forefront and exploration stage of international finance. Scholars and research institutions in various countries are actively involved in relevant research and practices. The only global environmental finance magazine defines carbon finance as follows: "finance problems related to global climate change." Carbon finance primarily includes renewable energy sources certification, "green" investment, weather risk management, and the carbon emissions market. Carbon finance, including elements such as markets, institutions, products, and services, should be the solution to climate change. Carbon finance establishes an important segment to manage climate change and a low-cost method to achieve sustainable development, to reduce and adapt to climate change, and to manage the disaster. It is also the core economic method of low-carbon development. The international carbon finance system includes three primary parts: the carbon finance market system, the carbon finance organization service system, and the carbon finance policy support system (Wang, Y. 2010). The function of carbon finance is to shift environmental risks, improving the environment, reduce finance risks, and increase social benefits. These objectives are obtained by taking advantage of various financial institutional arrangements and trading activities aimed at greenhouse gas emission reduction. Finance market tools and finance services such as carbon emission rights and derivatives trading, investment in and capital raising for low-carbon project development, carbon insurance, carbon funds, and relevant financial consulting services are utilized (Du & Li 2012). This article defines "carbon finance" as all finance activities that benefit carbon dioxide reduction, including capital-raising activities for low-carbon projects, carbon derivatives trading, and relevant consulting and guarantee activities. Thus, combining the business characteristics of commercial banks and based on the reduction of enterprise actual production and operations, this article

proposes a revenue model for commercial banks to develop their carbon finance businesses and comparatively analyzes the revenue conditions and primary elements of commercial banks' carbon finance businesses.

Literature Review

With the expansion of the carbon trading market carbon emission rights have become financial assets with investment value and liquidity. The phenomenon has generated a carbon trading currency and a carbon finance system supported by a series of financial derivatives such as direct investment, capital raising, bank loans, carbon index trading, and carbon options and futures (Ge 2012, Wang & Wang 2015). The international carbon trading market has great potential: carbon finance has become a new area of competition for global financial institutions, and the development of the carbon finance business by domestic commercial banks is an inevitable trend. One of the hot and difficult problems in the future research on carbon finance theory is that the financial institutions should study the operation mode and innovation of the carbon finance business on the one hand. On the other hand, the carbon financial institutions need to actively study the carbon finance business Its risk management in the carbon business (Xu & Li 2015).

In the field of theoretical research, international studies on carbon finance primarily focus on the carbon finance concept, choosing the carbon finance development approach, the trading price of carbon emission rights, product innovation in the area of carbon derivatives, and risk management and policy arrangements related to the carbon market. Studies on the carbon finance businesses of Chinese commercial banks remain rare, and future carbon finance systems and operational arrangements of commercial banks are the primary manifestations of financial institutions' participation in carbon finance. Recent years, scholars began to pay attention to the role of commercial banks in carbon finance, and the number of studies on such topic began to increase dramatically. The effective development of carbon finance became a topic that needed extensive discussions and is scholars' current focus (Liu & Liu 2016). Current studies show that domestic and international research in the area of "carbon finance" primarily focuses on macro policy, the carbon finance model, and the establishment of a carbon market institutional system.

Most studies merely focus on the macro aspect, whereas specific model research and empirical and case studies remain rare. In particular, China's carbon finance policy is relatively scattered and lies behind the development of carbon finance; also, a policy support system for such area has yet to be established. Regarding practice, China's carbon finance business is at the gradual-development stage, and the environment for developing carbon finance has essentially been created.

Studies show that commercial banks are monetary operation enterprises with the primary business of making deposits in and loaning money to industrial and commercial businesses with the objective of profit. These commercial banks' operating revenue and risk control have become key issues. The theoretical research on the carbon business of domestic commercial banks remains at the explorative stage, and most of the data are from international statistical materials. Thus, domestic empirical studies are rare. Research on empirical models can be divided into two categories: the first is the carbon finance business model, and the second is the commercial bank revenue model. In research on the carbon finance business model, Blyth et al. (2009) conduct a stochastic model analysis of carbon credit price dynamics, expand the often-used analytical framework of static marginal emission reduction costs, include policy effects and technology cost dynamics, and analyze carbon market dynamics and risk factors.

By establishing the game model of local government and commercial banks, Zhang & Li (2009) analyze not only government behavior according to different development views and institutional arrangements when the utility function changes but also the external conditions for green lending affected by such behavior. Using the closing price of carbon finance spots published daily by the BlueNext Exchange, Chun & Wang (2012) applied the extreme value theory (EVT) to establish models and analyzed the left and right 10% tails of revenue rates. Most studies on commercial bank revenue models adopt the concept of "residual income" to evaluate enterprise value and apply the complete residual income theory as the basic theoretical model for evaluating enterprise value. Zhang, Yang & Zhang (2015) studied the copula function method of dealing with the nonlinear correlation between risk factors, constructed the Copula-ARMA-

GARCH model and calculated Monte Carlo simulation of the integrated VAR of carbon market multi-source risk. Gao & Yu (2007) propose the asset volatility method and the income volatility method.

They apply the income volatility method and use the stock acquisition of Shenzhen Development Bank by Newbridge Capital as a case study to conduct a Monte-Carlo simulation by applying the matrix laboratory (MATLAB) procedure. Xu., Deng & Thomas (2016) develop a stylized model to investigate the impact of financial options on reducing carbon permit price volatility under a cap-and-trade system. Rogers et al. (2015) takes an integrated analysis approach to explore the options available for a UK homeowner to reduce their domestic emissions to the level advised by the UK governments Committee on Climate Change of 20% of those associated with a typical house in 1990.

At present, there is a lack of empirical model construction and analysis in the research of commercial banks' carbon finance business, especially the core and foundation of theoretical research. Therefore, this paper creatively constructs the carbon emission benefit model of commercial banks and reveals the income of China's commercial banks to carry out carbon finance business through hypothesis analysis.

The Revenue Model of Commercial Banks' Carbon Finance Businesses

This part first analyzed the introduction of emission-reduction equipment and the purchase of carbon emission rights by emission-reduction enterprises to determine their carbon emission amount and to further determine product cost. Next, based on enterprise financing, this part established a carbon finance revenue model by comparing the revenue of commercial banks that have carbon finance businesses. Last, this part discussed the theoretical conditions for commercial banks to develop carbon finance businesses.

The Amount of Carbon Emissions Reduced by Emission Reduction Enterprises

First, we determine the amount of enterprises' carbon emission. We consider a representative enterprise and assume that without any emission reduction measure, the enterprise's normal carbon emission is x ton, and the enterprise's restriction of its carbon emission is x_0 ton. Because $x_0 < x$, the enterprises must reduce their carbon emission to the standard x_0 ton. Here, we assume that the enterprise can reach the reduction standard by only two methods, with one method being the introduction of reduction equipment. Assuming the enterprise introduced n emission reduction equipment, the carbon reduction amount of each equipment is x_1 ton, but such equipment requires a huge amount of fixed assets investment. The other method is to purchase carbon emission trading rights from the carbon-trading market. Assuming the price of carbon emission rights is p yuan per unit and the carbon emission amount purchased by the enterprise is x_2 unit, the functional relation can be derived:

$$x = x_0 + nx_1 + x_2 \quad (1)$$

In the formula, x represents the amount of carbon emission of the enterprise without any reduction measure, x_0 is the enterprise's standard carbon emission, n is the number of pieces of reduction equipment, x_1 is the emission amount that each piece of equipment can reduce, and x_2 is the amount of carbon emission purchased from the carbon trading market.

The Production Costs of Emission Reduction Enterprises

Assume that the costs being considered here include only carbon-emission-related costs and the effects of output. In other words, if the output of the enterprise is constant, then:

$$c(x) = c(x_0 + nx_1 + x_2) \quad (2)$$

In the formula, $c(x)$ is the enterprise's production cost. Because $c(x)$ only represents carbon-emission-related costs, the more carbon emissions, the more cost savings. Thus, the production cost is negatively correlated to the carbon emission amount, and then:

$$\frac{dc(x)}{dx} < 0 \quad (3)$$

In the formula, x represents the carbon emission amount without any reduction measure by the enterprise,

and $c(x)$ is the production cost of the enterprise. The actual amount of carbon emission after the enterprise's emission reduction is the sum of its carbon emission rights and the rights that the enterprise has already purchased from the market. Accordingly,

$$x' = x_0 + x_2 \quad (4)$$

In the formula, x' is the actual amount of the enterprise's carbon emission, x_0 is the enterprise's carbon emission standard, and x_2 is the amount of carbon emissions purchased from the carbon trading market. Thus, the revenue obtained by the enterprise due to social and government recognition of its carbon emissions can be illustrated as:

$$R(x') = R(x_0 + x_2) \quad (5)$$

In the formula, $R(x')$ is the revenue obtained by the enterprise due to social and government recognition of its carbon emission. The more carbon emissions the enterprise has, the less revenue it can obtain from social and government recognition. Accordingly, revenue is negatively correlated to the actual amount of carbon emission. Therefore,

$$\frac{dR(x')}{dx'} < 0 \quad (6)$$

In the formula, x' is the actual amount of the enterprise's carbon emission, and $R(x')$ is revenue from the social and government recognition obtained by the enterprise.

Revenue Analysis of Commercial Banks' Carbon Finance Businesses

Enterprises' financing activities: Assuming the capital of the representative enterprise is all from bank loans, financing activities can be divided into two phases: the first phase is borrowing from commercial banks, and the second phase is repayment. The amount of money that the enterprise needs to borrow in the first phase is as follows. First is the production cost $c(x)$, which is borrowed based on the market interest rate r_0 . Second is the carbon emission rights purchased from the carbon trading market; the fee is px_2 , which is also borrowed at the market interest rate r_0 . Finally, the cost of purchasing n emission reduction equipment is nF , which is borrowed at the interest rate r_1 . Because the government and banks encourage enterprises to actively conduct emission reductions, interest rate $r_1 < r_0$. In the second phase, an enterprise's repayment amount can be illustrated as:

$$L = (1 + r_0)[c(x_0 + nx_1 + x_2) + px_2] + (1 + r_1)nF \quad (7)$$

In the formula, L is the enterprise's total repayment amount, r_0 is the market interest, and r_1 is the favorable interest rate. Because the enterprise reducing carbon emission can obtain social and government recognition and obtain revenue, the enterprise net repayment amount is as follows:

$$NL = (1 + r_0)[c(x_0 + nx_1 + x_2) + px_2] + (1 + r_1)nF - R(x_0 + x_2) \quad (8)$$

In the formula, NL is the enterprise net repayment amount, and $R(x_0 + x_2)$ is the revenue obtained by the enterprise from carbon emission reduction. The problem then becomes to seek the minimum of NL under independent variables n and x_2 . The first-order conditions are as follows:

$$\frac{dNL}{dn} = (1 + r_0)c'(x_0 + nx_1 + x_2)x_1 + (1 + r_1)F = 0 \quad (9)$$

$$\frac{dNL}{dx_2} = (1 + r_0)c'(x_0 + nx_1 + x_2)n - R'(x_0 + x_2) = 0 \quad (10)$$

Once the minimum net repayment amount has been determined, commercial banks' revenue from providing financing for enterprises that reduce their carbon emission can be determined. Because commercial banks provide loans at favorable rates to assist enterprises in reducing carbon emission and environmental pollution caused by production, enterprises will obtain social benefits (such as government rewards, social honors, good will, and image improvement), which can be illustrated by the following formula:

$$W_1 = r_1 nF + r_0 [c(x_0 + nx_1 + x_2) + px_2] + R(r_1) \quad (11)$$

In the formula, W_1 is the revenue of commercial banks that provide financing for carbon finance projects, and $R(r_1)$ is the social benefit commercial banks will obtain. Commercial banks' revenue from regular loans is as follows:

$$W_2 = r_0 nF + r_0 [c(x_0 + nx_1 + x_2) + px_2] \quad (12)$$

In the formula, W_2 is commercial banks' revenue from regular loans. The revenue difference under these two conditions is as follows:

$$W' = r_1 nF + R(r_1) - r_0 nF \quad (13)$$

In the formula, W' is the difference between commercial banks' revenue from carbon finance projects and regular loans, which is $W_1 - W_2$.

Based on the preceding, realistically speaking, to encourage commercial banks to participate in carbon finance projects, it is necessary to ensure that they can obtain more revenue and higher profits from carbon finance projects. According to formula (13), $r_1 < r_0$ and thus, $(r_1 - r_0)nF < 0$. Represents the social benefit obtained by commercial banks from carbon finance project financing; $R(r_1) > 0$. Thus, the condition for $W' > 0$ is $R(r_1) > (r_0 - r_1)nF$. In other words, the social benefits obtained by commercial banks from carbon finance project financing outweigh the revenue decrease resulting from the favorable rate.

Therefore, based on the preceding analysis and comparison, it can be concluded that commercial banks' carbon finance businesses are affected by various factors such as financing revenue, social benefit, reduction in enterprise's financing activities, and government interest rates. Also, it is worth noting that the risks of commercial banks' carbon finance businesses are unavoidable. Therefore, the measurement of operational risks is the core and foundation of commercial bank risk management. The EVT and the Loss Distribution Approach (LDA) can be used to measure commercial banks' operational risks. Feng et al. (2011) analysis of Chinese commercial banks' operational risks and loss data indicates that the results of the two measurement methods have a relatively high degree of consistency, whereas the difference in the results from two types of distributions using the LDA is larger than the difference in the two methods. From a policy perspective, the risks of EVT and LDA arise out of the application process rather than the model selection. Thus, what is important is how banks apply the selected models.

Conclusion

By analyzing the production and operation of representative emission reduction enterprises, this article

creatively established the theoretical model for commercial banks' development of carbon finance businesses and subsequently studied their revenue. The study finds that commercial banks' carbon finance businesses are affected by various factors such as financing revenue, social benefit, and reduction in enterprise's financing activities, and the government interest rate. When the social benefits obtained by commercial banks from carbon finance project financing outweigh the revenue decrease resulting from the favorable rate, the revenue of commercial banks from carbon finance projects outweighs that from regular loans. This article theoretically confirmed that commercial banks' carbon finance businesses could increase their operating revenue and can facilitate the achievement of the win-win objective of emission reduction enterprises and commercial banks.

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