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The impact of financial development on carbon emissions: An empirical analysis in China

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ABSTRACT

Given the complexity between China's financial development and carbon emissions, this paper uses some econometric techniques, including cointegration theory, Granger causality test, variance decomposition, etc., to explore the influence of financial development on carbon emissions. Results indicate that, first, China's financial development acts as an important driver for carbon emissions increase, which should be taken into account when carbon emissions demand is projected. Second, the influence of financial intermediation scale on carbon emissions outweighs that of other financial development indicators but its efficiency's influence appears by far weaker although it may cause the change of carbon emissions statistically. Third, China's stock market scale has relatively larger influence on carbon emissions but the influence of its efficiency is very limited. This to some extent reflects the relatively lower liquidity in China's stock markets. Finally, among financial development indicators, China's FDI exerts the least influence on the change of carbon emissions, due to its relatively smaller volume compared with GDP; but it is mainly utilized in carbon intensive sectors now, therefore, with the increase of China's FDI in the future, many efforts should be made to adapt its utilizing directions and play its positive role in promoting low-carbon development.

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1. Introduction

China now has become the largest carbon emitter in the world with the share 24.2% of the total in 2009 (BP, 2010). And in the long future, with the process of industrialization and urbanization, China's economy will continuously grow, which may inevitably cause ever-increasing carbon emissions. Under this circumstance, in order to effectively promote sustainable development of socio-economy and address global climate change, Chinese central government promised to reduce 40–45% carbon emissions intensity (carbon emissions per unit of GDP) by 2020 compared with the 2005 level. But, a dilemma has popped up for China between increasing national income and reducing carbon emissions, which has attracted extensive attention but the conclusions are not consistent and the solution proves unclear till now.

In fact, the carbon emissions in a country do not necessarily depend on its income level alone; financial development may be another source. In an economic entity with ever-deepening financial systems, the growing role of financial development in

carbon emissions increase tends to be continuously augmented for several reasons. First, financial development may attract foreign direct investment (FDI) so as to accelerate economic growth and increase carbon emissions (Frankel and Romer, 1999). Second, prosperous and efficient financial intermediation seems conducive to consumers' loan activities, which makes it easier for consumers to buy big ticket items like automobiles, houses, refrigerators, air conditioners, washing machines, etc., and then emit more carbon dioxide (Sadorsky, 2010). In addition, stock market development helps listed enterprises to lower financing costs, increase financing channels, disperse operating risk and optimize asset/liability structure, so as to buy new installations and invest in new projects and then increase energy consumption and carbon emissions (Dasgupta et al., 2001).

However, there are also some authors opposing to the arguments above. For instance, Tamazian et al. (2009) emphasize that financial development helps listed enterprises to promote technology innovation and adopt new technologies, so as to increase energy efficiency and advance low-carbon economic development; consequently, the carbon emissions intensity may be cut significantly. Besides, Claessens and Feijen (2007) find that those enterprises with more advanced governance often are more willing to consider low-carbon development; therefore, financial development may spur enterprises' performance and then reduce energy consumption and carbon emissions.

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As a result, it can be found that the nexus of financial development and carbon emissions appears unclear up to now, and further empirical study is necessary. In fact, this kind of work is of great importance for China to scientifically design the path for carbon emissions intensity reduction and reasonably evaluate the difficulty to realize the carbon emissions intensity reduction target by 2020. Because if there is a significantly positive relationship between financial development and carbon emissions, then further development in China's financial sector may increase emissions in a way that has not been accounted for. This will make it more difficult for China to meet its planned emissions reduction targets.

The rest of the paper is organized as follows. Section 2 presents the empirical literature review related with financial development and carbon emissions. Section 3 puts forward research data definitions and empirical methodologies in this paper. Empirical results are given in Section 4, and Section 5 concludes the paper.

2. Related literature review

Among empirical study literature, financial development mainly includes the development of financial intermediation, stock market, foreign direct investment (FDI), etc. In fact, a large body of research implies that financial development has become an integral part to spur economic development, and basically plays a positive role in adjusting economic development. [Levine \(1997\)](#) argues that due to the market conflicts caused by the existence of trading cost and information cost, the role of financial intermediation is to eradicate those conflicts so as to lubricate the savings and optimize the capital allocation. [Han \(2001\)](#) holds that well-built financial markets and smooth transferring mechanisms are conducive to saving increase and effective transformation from saving to investment, and then promote capital accumulation, technology advance and economic growth in the long run.

Numerous empirical studies are found on the nexus between China's financial development and economic growth. Summarily, we may see that the research ways include three levels, i.e., on the national, regional and provincial ones ([Tan, 1999](#); [Zhou and Zhong, 2004](#); [Du, 2008](#); [Zhang and Hu, 2003](#); [Hasan et al., 2009](#)). In addition, the research methods mainly involve in some econometric models, such as cointegration theory, error correction model, Granger causality test approach, etc. And the research conclusions basically argue that financial development spurs economic growth, but the magnitude varies in different regions of China.

Besides, a large number of studies focus on the relationship between economic growth and carbon emissions, especially the discussion about the Environmental Kuznets Curves (EKC) curve, but their conclusions differ a lot ([Soytas et al., 2007](#); [Soytas and Sari, 2009](#); [Tamazian et al., 2009](#)). As for that in China, existing research indicates that China's economic growth is closely related with carbon emissions; especially in the recent decade, we can see the significant driving influence of economic growth on carbon emissions ([Zhang and Cheng, 2009](#)) and the restraining influence of carbon emissions on economic growth ([Chen et al., 2004](#)).

Comparatively, little research analyzes the influence of financial development on carbon emissions and energy consumption. [Sadorsky \(2010\)](#) explores the influence of financial development in 22 emerging countries (including China) on energy consumption using a panel data model, and argues that, as a whole, financial development in these countries significantly promote the increase of energy consumption. [Tamazian et al. \(2009\)](#) investigate the relationship among economic growth, financial development and environmental quality in the BRIC countries,

and find that financial development proves a key factor to cut carbon emissions. Similarly, [Tamazian and Bhaskara Rao \(2010\)](#) point out that financial development in transition countries may exert evident influence on carbon emissions.

It should be noted that existing empirical research on financial development often takes FDI as one of the financial development indicators although traditional financial development theory does not necessarily cover FDI. In fact, there are many studies on the influence of FDI on environment quality, but the conclusions have not come to a consensus. For instance, [List and Co \(2000\)](#) and [Mielnik and Goldemberg \(2002\)](#) find that the inflow of FDI helps to promote energy efficiency of the host countries and cut their environmental quality. [Xing and Kolstad \(2002\)](#), however, argue that there exists a positive relationship between FDI and pollutant emissions in the host countries. Therefore, we can say that the nexus between FDI and carbon emissions remains unclear up to now. Hence further study should be conducted to evaluate whether FDI has caused China to be a carbon dioxide haven of developed countries for its relatively loose environmental regulations.

As a whole, the previous related literature provides us with helpful references; however, as for the nexus of financial development and carbon emissions in China, there are at least two problems to be investigated further.

For one thing, existing literature often measures financial development in an aggregate way when the relationship between financial development and carbon emissions is concerned, while it seldom distinguishes the financial scale and efficiency and also rarely explores the role of stock markets in a specific way.

For another, the nexus between China's financial development and carbon emissions has not been discussed to our best knowledge. Actually, China's financial development has its own characteristics. For instance, numerous studies often use the ratio of deposits (or the sum of deposits and loans) to GDP to measure China's financial development level ([Tamazian et al., 2009](#); [Sadorsky, 2010](#)), but according to the China Statistical Yearbook, there is substantial difference between the deposits and loans of China's financial institutions; specifically, about 20–35% of deposits have been sleeping in banks in the past decade. Thus, the ratio of deposits to GDP can hardly describe the financial development level in China. And since the loans are closely related with the activities of enterprises, the ratio of the bank loans to GDP may be more reasonable, which in fact has been commonly used in some previous financial development literature for other research purposes ([Giuliano and Ruiz-Arranz, 2009](#); [Hasan et al., 2009](#); [Yuxiang and Chen, in press](#)).

In response to these problems, this paper uses some quantitative methodologies, including Johansen cointegration test, modified Granger causality test, variance decomposition, etc., to explore the influence of China's financial development on carbon emissions from two perspectives, i.e., financial development scale and efficiency, not only for financial intermediation but also for stock markets.

3. Data definitions and empirical methodologies

3.1. Data definitions

When financial development is concerned, one of the popular definitions focuses on its scale, such as the sum of bank loan, stock market capitalization and bond market capitalization divided by GDP, but China's bond market emerged in 2005, with very short time series, and its influence on the whole financial system of China appears limited till now; therefore, this paper

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