DOES GREEN FINANCE CROWD OUT CONVENTIONAL INVESTMENT IN CHINA?

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Abstract

This study examines whether the growth of green finance in China exerts a crowding-out effect on traditional investment by analyzing the dynamic spill-over relationships between green and conventional financial returns. The current research discusses the dynamic relation between green and conventional finance, similar to Peng et al. (2023). The study utilizes daily time series data and applies the Diebold-Yilmaz (DY) spillover index and Baruník–Křehlík (BK) frequency domain decomposition, and tries to capture both total and directional connectedness across different time horizons. The outcomes reveal a marginal but, to some extent, increasing level of interdependence with traditional investments. Historically, these act as net transmitters of volatility, particularly green finance, which depicts rising influence during periods of market turbulence, demonstrating its evolving systemic importance. The frequency domain analysis further distinguishes the short-term responsiveness of green returns, which is found to mark sharp volatility spillovers during a crisis. The findings of this study do not confirm a complete crowding out of traditional finance. However, they indicate a transition towards movement together and competitive coexistence. The results offer important implications for policymakers and researchers who are seeking to balance sustainability goals with financial stability.

Keywords: Green Finance, Crowding Out, Spillover Analysis, Chinese Listed Companies, Conventional Investment

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1. INTRODUCTION

In recent years, a major shift in global finance toward sustainability-focused investment has been observed. The reason behind this is rapidly increasing concerns about the environment. The problems related to the environment, like climate change and global warming, have been

increasing rapidly in recent years. These problems threaten the survival of mankind and even make the conditions worse for future generations (Su et al., 2020). That is a major reason for this shifting attention toward green finance. In the era of ongoing challenges regarding environmental changes and loss of biodiversity, moving toward green finance and opting for the financial flow toward sustainable practices is the only solution (Organisation for Economic Co-operation and Development [OECD], 2021). China, being the world's second biggest economy, is a contributor of carbon dioxide and needs to adopt a green transformation. The authorities of China have enthusiastically promoted green finance via development projects and policy reforms.

The introduction of green bond standards, green credit guidelines, and support for green stock indices (People's Bank of China [PBoC], 2016) are also significant in this perspective. Where climate and environmental considerations are increasingly being considered in the financial and economic decision-making to achieve the carbon neutrality target, simultaneously, the greening of financial sectors is also emphasized. To support green projects, key initiatives include education expenditure, investment in research and development (R&D), energy-efficient technologies, and transition towards renewable energy. Each of them plays a crucial role in advancing sustainable finance (Berrou et al., 2019).

Presently, financial sectors are increasingly focusing on green financial instruments, such as green investments, green loans, bonds, and stocks, to promote a sustainable environment (Naqvi et al., 2022; Sachs et al., 2019). There is overwhelming support in the literature that green investment (green finance) plays a leading role in upgrading the existing industrial structure (Gu et al., 2021; Wang et al., 2022), promoting efficient resource usage (Lee & Lee, 2022), providing access to advanced and energy-efficient technologies (Zhang et al., 2022) and facilitating the installment of renewable initiatives and projects (Taghizadeh-Hesary & Yoshino, 2020). In this way, it is reasonable to propose that green finance is a critical factor that helps to achieve the carbon neutrality target. While this momentum has spurred optimism about financing the low-carbon transition, an unresolved question remains whether green finance merely reallocates existing capital away from traditional sectors, thereby crowding out conventional investment, or whether it is complementary to that.

The notion of crowding-out is traditionally discussed in fiscal policy literature; however, this term is introduced in the discourse of financial sustainability. It implies that the expansion of one form of investment, in our case, green finance, might lead to a reduction in other types of investment. It happens due to limited financial resources, portfolio constraints, and regulatory incentives (Eyraud et al., 2013; Chen et al., 2021). The concern is particularly pertinent in economies like China, as the rapid structural change there is unending and the financial system is still maturity. Green finance has the potential to unlock new sources of capital and stimulate innovation in green sectors (Zhang et al., 2022). This can lead to problems like using resources in the wrong way and unfair advantages in the market, which can make traditional industries less competitive (Wang & Zhi, 2016; Li et al., 2022).

Empirical research on the nexus of green and conventional finance is at an early stage. Most of the studies have primarily focused on the positive externalities of green finance, such as carbon neutrality and innovation capacity (Wu et al., 2025; Feng, 2022). Although green finance is widely encouraged for promoting sustainability, very few studies have carefully explored whether it might have unintentionally affected the conventional investments. It is not certain yet if prioritising green projects could unintentionally reduce investment in other essential sectors, as Zhang et al. (2021) found that green credit allocation in China may crowd out small- and medium-sized enterprises in traditional sectors. It is imperative to know, as it may disrupt the overall flow of capital from traditional sectors. The possible side effects of green finance on the wider economy and investment patterns are still not well understood and need more in-depth research.

Understanding the crowding-out hypothesis in the context of green finance is particularly relevant for China because the policy measures there seek to achieve dual goals that are decarbonization and economic stability. The green finance system of China has evolved rapidly since the launch of its Green Finance Reform and Innovation Pilot Zones in 2017 and the subsequent release of the Guidelines for Establishing the Green Financial System (PBoC, 2016). China's green bond issuance has surged to the second largest in the world between 2016 and 2022. It is observed that green credit balances reached over CN¥20 trillion in 2022 (Wang, 2022). This rapid expansion enquires whether the traditional capital is completely interchangeable and, in the future, whether green finance will completely displace it.

The financial system of China is currently evolving, which adds another layer of complexity to the system. Unlike advanced economies that have liberalized markets, China operates under a partially controlled financial system with the state playing a major role in directing credit flows. This model allows for specific actions, like green credit scooters for financial incentives, but at the same time, it can lead to problems. If capital is not distributed based on market needs (Huang, 2010a, 2010b). Finance can support sustainability-focused investment may cause inefficiencies if traditional sectors receive less investment. This raises concerns about broader financial risk (Zhang & Tsai, 2024). This is particularly noticeable as the interaction between green finance and shadow banking, real estate finance, and local government debt remains underexplored. All these raise serious concerns about systematic implications.

The measurement of green versus conventional investment definitions of green finance varies across different institutions; some projects are labelled clean without any substantial environmental benefit (Tang & Zhang, 2020). Whereas some conventional investments may indirectly contribute to sustainability through efficiency improvements, to tackle these rigorous methodologies are required to isolate the net effect of green financial flows on unknown green sectors.

In lieu of growing concerns about green versus traditional finance, this study investigates the question:

RQ1: Does green finance crowd out conventional investment in China or not?

It is essential to determine whether these growing capital flows are diverting financial sources from traditional industries or promoting an overall increase in investment. This study assesses how the relationship between green and conventional finance is established across the Chinese economy. For this, the study examines the spillover effects between green and conventional finance in China by using an advanced time series technique, that is, the Diebold-Yilmaz (DY) spillover index and Baruník–Křehlík (BK) frequency domain decomposition. The methods will help to capture both short-term and long-term volatility transmission.

The goal of this research is to investigate whether the Chinese green finance expansion has essentially displaced traditional investment. This research also investigates the time-based dimensions of these effects and differentiates between short-run and long-run investment behavior. This discussion determines the crowding out detected in the transitional outcome of financial alignment or made a structural modification in capital provision. Moreover, this research is essential because it explores the areas that have not been addressed yet. The rapid growth of green finance in China is reducing the investment in projects that are not focused on the environment. After studying the connectedness of green and traditional financial investment, the researchers will start understanding what happens to the economy as a whole when an economy starts moving toward environmentally friendly practices. The findings will help policymakers in balancing sustainability goals with economic stability at the same time, particularly in a transitioning economy like China.

The remaining structure of the paper is as follows. Section 2 reviews the relevant studies. Section 3 outlines the methodology and data sources. Section 4 demonstrates the findings and discussion of the study, and Section 5 concludes the paper along with some recommendations and research directions.

2. LITERATURE REVIEW

2.1. Theoretical background

The current study is based on the framework of two key theories. The first theory is the financial intermediation theory (Diamond, 1984), while the other is the portfolio rebalancing hypothesis (Campbell, 2017). The first theory is of the view that banks and financial institutions allocate capital by considering risk levels, expected returns, as well as regulatory guidelines. Therefore, when green finance is supported through incentives like lower capital requirements and better reputation, these financial institutions may choose to reduce funding to conventional sectors. Especially those that are less profitable and riskier. The second theory suggests that asset managers responding to regulatory demands and market practices often restructure their investment portfolio to include more green instruments. By reallocating this way, they reduce the share of capital flowing into traditional industries unless they focus on enhancing the investment pool at the same time.

Moreover, other theories of capital allocation under constraint optimization also demonstrates that investors under continuous regulatory pressures and risk-based constraints prefer their capital to invest in environmentally friendly projects (Busch et al., 2016; Battiston et al., 2017) In light of these studies, it is established that this shifting of capital although supports climatic goals it may also create imbalances in investment landscape which may potentially harms traditional industries and effect overall economic efficiency (Acemoglu et al., 2012; Bhandary et al., 2021).

2.2. Review of literature

Green finance theory was presented by Salazar (1998), who acknowledged that green finance strongly prioritizes environmental benefits while focusing on economic productivity at the same time. Green finance is a deliberative instrument, potentially increasing economic efficiency while ensuring environmental sustainability (Cowan, 1998; Labatt & White, 2002). Despite the growing practical importance of green finance, studies on green finance are lacking in mainstream literature, as it is an emerging research area. It is worth mentioning that only a limited number of scholars have sought to investigate the topic of green finance versus traditional finance. The majority of studies have been conducted exclusively in the context of China, focusing on the green finance and environmental quality nexus. The existing literature shows that numerous researchers have used green bonds as a proxy for green investment to measure green finance. Green bonds are a type of green investment that is used to finance green projects and hence help to limit carbon emissions (Bhutta et al., 2022). Chang et al. (2022) discussed the promising role of green bonds in limiting various environmental disputes. The study acknowledged that green bonds help to finance green projects and promote sustainability. Agliardi and Agliardi (2019) documented that green bonds are an efficient channel that helps to limit universal environmental problems. Sartzetakis (2020) also reported similar results. Wan and Sheng (2022) utilized the data from 30 provinces of China and confirmed that green investment reduces the CO2 from a certain threshold.

Pham (2016) was one of the early researchers to study green bond market behavior, using a multivariate generalized autoregressive conditional heteroskedasticity (GARCH) model to analyze volatility. The study found that green bonds tend to show greater volatility clustering compared to conventional bonds. Building on this study, several follow-up studies have applied similar comparative approaches.

Karpf and Mandel (2017) studied green bond yields and suggested that they might offer higher returns due to their credit characteristics. This implies that the investors might prefer them over conventional finance. Similar findings were revealed by Bachelet et al. (2019). In contrast to this, Baker et al. (2018) argued by introducing an asset price model that accounts for investor preferences for gain attributes. The findings of the study depicted that green bonds tend to have slightly lower issuance yields than conventional bonds. Gianfrat and Peri (2019) and Zerbib (2019) both supported this idea by showing that green bonds typically offer lower returns. Their study also contrasts with

the findings of Febi et al. (2018), who maintained by declaring that issuing green bonds can lead to positive stock returns and there is a liquidity premium in green bond yields. However, the outcomes of the study of Baulkaran (2019) signalled broader investor approval and market benefits of green finance.

Tang and Zhang (2020) explored shareholders' reactions to green bond issuance in China and found a positive market response and better environmental information disclosure. They also demonstrate that green bonds do not necessarily have less borrowing cost, but they attract new capital without crowding out traditional investments. This challenged the idea of a strict crowding-out effect. On a similar behavior, Reboredo and Ugolini (2020) inspect network connectedness with the regularity realm and highlight the nature of cross-market connections. Reboredo (2018) examined the relationship between green bonds and other financial instruments. He noticed a strong co-movement between the two. Broadstock and Cheng (2019) also noticed an interesting fact that macroeconomic variables significantly influence the correlation patterns between green bonds and the traditional bond market. Reboredo and Ugolini (2020) examined price transmission mechanisms and concluded that green bonds generally act as net receivers of price spillover rather than sources. Similarly, Nguyen et al. (2020) used a frequency domain approach to investigate how co-movement patterns differ across short and long-term investment horizons. Huynh et al. (2020) and Le et al. (2021) adopted comparable analytical methods. They examined the transmission of returns and volatility between green bonds and emerging financial assets such as artificial intelligence (AI) stocks, robotics, fintech instruments, and cryptocurrencies. Both studies highlighted the importance of investment horizons and time-varying characteristics in understanding green bond interactions. Taking a broader risk-based perspective, Gyamerah et al. (2022) examined tail dependencies and identified asymmetric spillover effects from clean energy stocks to green bonds and found that upside risks were more strongly transmitted than downside risks.

Su et al. (2022) used time frequency analysis MVMQ-CAViaR model, to study Chinese green bonds with other assets and found strong linkages to fixed income assets and their exposure to extreme risks. The study also found weak spillovers from green bonds and energy commodities, which suggests that there is less investor preference for green investment in China. Taghizadeh-Hesary and Yoshino (2019) argued that the green finance supported by proper policies can mobilise private capital without actually diverting it from traditional sectors. Their conceptual model implied that green finance can catalyse rather than cannibalize conventional investment. But the precondition to this is well-designed financial and regulatory systems. Khalil and Nimmanunta (2023) explored the shift in investment trends from conventional to green finance by focusing on the role of innovation and financial performance with environmental benefits. The study disclosed that green investments offer competitive financial returns compared to traditional investments, and green finance promotes environmental sustainability along with financial innovation. In the same year. Peng et al. (2023) investigated the spillover effects between green markets and conventional markets by using econometric models to measure the interdependency and market dynamics. They concluded that there are significant spillover effects with green bonds increasingly influencing traditional bond markets. They further maintained that these spills over are more noticeable in economic uncertainty. Peng et al. (2023) have changed perceptions about green finance. They explored the green finance role supporting sustainable development practices and its incorporation with the conventional market. The researchers developed the mechanism through which green finance can accomplish environmental and financial goals, respectively. They conclude that the implication of green finance is essential for the achievement of sustainable development without compromising financial stability. Belguith (2025) explored the hedging efficiency of green bonds compared to conventional bonds. Their research was focused on possible ways to minimize portfolio risk, along with sustainability. The research disclosed that green bonds offer actual hedging contrary to market risks. Particularly, in the period of environmental and financial crises. The findings provide significant sustainable benefits in comparison to conventional bonds.

This literature concludes a comprehensive landscape of interaction between green and conventional finance. The studies established both the existence of crowding in and crowding out effects.

2.3. Hypotheses development

Most existing studies focus on either its environmental impact, market performance, or its potential to attract new investors (Cowan, 1998; Labatt & White, 2002; Zhang et al., 2022). Limited attention has been given to whether green finance leads to the reallocation of capital away from conventional sectors (Taghizadeh-Hesary & Yoshino, 2019; Khalil & Nimmanunta, 2023). Current research often lacks comprehensive empirical analysis that captures dynamic relationships examined, yield spreads, volatility, or stock returns following green bond issuance (Karpf & Mandel, 2017; Pham, 2016). There remains a lack of systematic investigation into the spillover effects between green and conventional financial instruments using advanced time-series methods. Moreover, studies examining the temporal variation of whether such effects are short-lived or persistent are scarce. Therefore, this study fills an important gap by examining whether green finance in China displaces conventional investment or is complementary, using frequency-domain decomposition and spillover analysis over a multi-year daily dataset.

The following hypotheses are developed for the study:

H1: Traditional financial assets act as net transmitters of volatility to green assets in the short term, particularly during periods of financial stress.

H2: Green finance does not exhibit a strong or consistent crowding-out effect on conventional investment; instead, evidence points to co-movement and competitive coexistence.

H3: The crowding-out effect, where present, is more pronounced in the short term than in the long term, suggesting it may be a transitional outcome rather than a structural shift.

3. METHODOLOGY

This study aims to empirically examine whether green finance crowds out conventional investment across sectors in China by analysing return spillovers using advanced econometric techniques. The methodology is designed to capture both the intensity and the direction of volatility transmission from green to conventional sectors and vice versa, leveraging innovations in connectedness measures. Specifically, the analysis is centred around the DY spillover index and its extension into the BK frequency domain.

3.1. Data description

To compare conventional and green finance performance in China, this study uses two indices: the CSI 300 for conventional finance and the CSI 300 ESG as a proxy for green finance. The CSI 300 includes the largest 300 A-share stocks, while the environmental, social, and governance (ESG) version filters these based on ESG criteria. Daily index data from July 6, 2017, to December 31, 2024, is collected from the Wind Financial Terminal.

To ensure consistency and comparability, raw prices are converted into logarithmic returns:

$$r_{i,t} = ln(P_{i,t}) - ln(P_{i,t-1}) \quad (1)$$

where, $r_{i,t}$ is the return of sector (i) at time (t), and $P_{i,t}$ is the closing price of the stock. This transformation removes scale effects and ensures that data conform to the stationarity requirement for subsequent time-series modelling.

3.2. Spillover analysis using the DY framework

Traditional vector autoregressive (VAR) models are widely used to capture interdependencies among financial or economic variables over time. They fall short in explicitly quantifying how much shocks in one variable influence others. VARs model typically focuses on impulse responses or Granger causality. These models are informative but do not directly measure the intensity and directionality of spillovers across time series. Due to this limitation, these are not appropriate for the studies that seek to understand systemic transmission effects or dynamic inter-sectoral linkages in financial markets.

To overcome these limitations, the current research uses the DY spillover index (Diebold & Yilmaz, 2009, 2012). It is a tool that measures the magnitude and direction of connections between variables. This index decomposes forecast error variance to show how much each variable is influenced by the other variable. This framework identifies directional spillovers. It highlights both the influence a variable receives and transmits. This characteristic makes it useful for determining whether a net transmitter of a shock or a receiver of shock.

In this study, the DY spillover index examines the relationship between green finance and commercial finance. It helps to assess where the shocks from green financial instruments spillover into traditional markets. A pattern of green finance transmitting volatility may indicate crowding out; on the other hand, mutual or traditional finance-driven spillovers suggest a complementary behaviour. The DY index is an ideal methodology for time series data to calculate net spillover.

3.3. Generalized forecast error variance decomposition

The generalised forecasting error variance decomposition (GFEVD) breaks down the forecast error variances of each return series into parts to show how much each part is being influenced or affects the others. The generalized approach is invariant to the ordering of variables.

Let θ_{ij} (H) denote the contribution of shocks in variable j to the forecast error variance of variable i over horizon H. These breakdowns are also normalized so that adding all contributions equals one.

3.3.1. Total spillover index

The total spillover index (TSI) measures the overall connectedness in the system:

$$TSI = \frac{\sum_{i=1}^{n}\sum_{j=1,j\neq i}^{n}\theta_{ij}^{(H)}}{\sum_{i=1}^{n}\sum_{j=1}^{n}\theta_{ij}^{(H)}} \times 100 \quad (2)$$

A higher TSI suggests greater symmetric risk and integration among sectors, indicative of stronger influence.

3.3.2. Directional spillovers

Directional spillovers provide source-specific decomposition. Spillovers transmitted from sector j to all others:

$$S_{j\to *} = \sum_{j=1,j\neq 1}^{n}\theta_{ij}^{(H)} \quad (3)$$

Spillover received by sector j from all other sectors.

$$S_{*\to j} = \sum_{j=1,j\neq 1}^{n}\theta_{ij}^{(H)} \quad (4)$$

This distinction is vital for identifying whether green finance sectors are primarily shock originators or recipients in relation to conventional sectors.

3.3.3. Net spillovers

The net spillover is the change between the directional transmitted and received values.

$$NS_j = S_{j\to *} - S_{*\to j} \quad (5)$$

When green finance has a larger impact on traditional investment is known as a positive spillover. It also recommends crowding them out.

Contrary to this, in negative spillover, green finance is more inclined by the traditional sector. It also describes how the green finance and traditional sectors are accompanying each other.

3.4. Frequency domain spillovers (BK decomposition)

The DY framework provides a dynamic view of spillovers within a system. It treats all shocks equally, regardless of their duration. In financial research, responses to short-term volatility differ from those to long-term trends. To address this, this study uses the BK spillover decomposition (Barunik & Křehlík, 2018), which extends the DY approach into the frequency domain. The BK framework separates spillover by frequency, allowing for the analysis of both short-term and long-term effects.

The BK method assumes that shock impacts vary across different investment horizons. Short-term spillovers often reflect market noise, while long-term spillovers are driven by macroeconomic fundamentals, regulatory changes, or shifts in investor sentiment. This is particularly relevant for green finance, where policy changes and ESG regulations develop over time. As news shocks or investor reactions are more immediate. The BK approach enables analysis of spillovers across different types of frequencies, which is essential in markets with varied investor behaviors. For example, long-term investors may react more to low-frequency shocks, while short-term traders may focus on high-frequency events.

In this study, Bk decomposition helps to explore whether spillover effects between green and traditional finance vary by time horizon. Greater long-term spillovers from green finance could indicate a structural shift. The BK framework provides a deeper understanding of when and how spillover occurs.

3.5. Motivation for frequency decomposition

It is necessary to use frequency decomposition because crowding out of investment may vary across various investments. For instance:

1) In the short term, capital may reallocate rapidly due to sentiment, policy signals, or regulatory shifts.

2) In the long term, crowding-out might manifest via slower structural realignments in portfolio allocations or capital expenditures.

Therefore, distinguishing between high-frequency (short-run) and low-frequency (long-run) spillovers allows for more nuanced inference.

The frequency-specific spillover from sector j to i is computed by adding up the effects within a specific frequency range. Summing these for $i \neq j$ gives both directional and total spillovers across different frequencies.

3.6. Interpretation of frequency components

Short-term spillover from green to conventional sectors reflects a temporary market reaction. On the other hand, long-term spillovers suggest green finance is reshaping traditional investments. The DY and BK framework allows the study to track green finance's effects on traditional sectors over time. This distinguishes between short-term noise and long-term trends.

Mathematically, let $d \in (0, \pi)$ represent a specific frequency. The spectral representation of GFEVD allows calculation of spillover measures within the frequency bands mentioned in Table 1 below.

Table 1. Frequency bands and corresponding time horizons BK frameworks

Band	*Frequency range (Radians)*	*Time horizon (Approx. days)*
Short-term	$(\pi/4, \pi) = (0.785, 3.14)$	2 to 8 days
Long-term	$(0, \pi/4) = (0.000, 0.785)$	8+ days

Source: Authors' elaboration.

Table 1 depicts the short-term and long-term spillover effects based on their frequency ranges in radians. The short-term band (0.785–3.14 radians) corresponds to a 2–8 day time horizon. The long-term band (0–0.785 radians) covers periods beyond eight days. This classification enables decomposition of dynamic connectedness into short-term temporary effects versus long-term structural effects.

4. RESULTS AND DISCUSSION

This section provides the findings and discussion of the study. Before conducting DY and Bk analysis, the descriptive analysis is important. Table 2 provides the descriptive statistics of the returns.

Table 2. Descriptive analysis

Variable	*Obs.*	*Mean*	*Std. dev.*	*Min*	*Max*
green_returns	1.819	0.000063	0.012363	-0.08119	0.080231
trad_returns	1.819	0.000045	0.01227	-0.08209	0.08142

Source: Authors' elaboration.

Descriptive statistics reveal that the green financial instrument's mean is slightly higher than that of traditional investments. Both show near-zero average returns. Green assets have a slightly higher standard deviation, which indicates marginally more volatility, but somehow both sectors experienced similar levels of return fluctuations.

Table 3. Directional spillovers and total connectedness between green and traditional returns

Metric	*green_returns*	*trad_returns*
To	40.79%	57.77%
From	57.77%	40.79%
Net	-16.98%	+16.98%
NPT (→ trad)	-16.98%	+16.98%
TCI	49.28%	

Note: NPT — net pairwise spillover transmission, TCI — total connectedness index.
Source: Authors' elaboration.

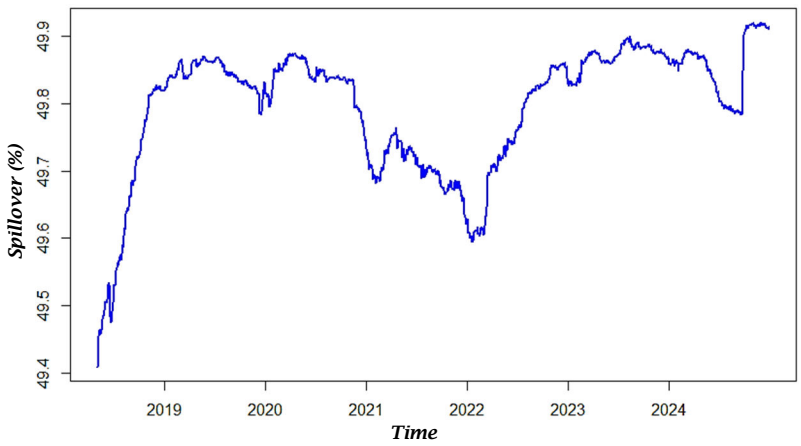
Table 3 provides the spillover estimates produced using the Diebold and Yilmaz (2012) variance decomposition framework. The decomposition matrix shows that green returns, which represent returns from green financial instruments, receive 57.77% of their forecast error variance from trade returns. This indicates high vulnerability to conventional financial shocks. In contrast, trade returns receive only 40.79% from green returns, suggesting a limited influence from green finance. This highlights that traditional finance is still the dominant force in shaping market volatility.

The "To" and "From" metrics confirm this, showing that green returns transmit only 40.79% of their volatility, while trade returns transmit a much larger portion. This results in a net spillover of -16.98% for green returns and +16.98% for trade returns, indicating that green finance is a net absorber of market shocks. The NPT also confirms that traditional investments influence green finance more than vice versa. These indicators emphasize that green finance remains dependent on conventional investment behavior.

The TCI stands at 49.28%, suggesting a moderate level of interdependence between green and traditional finance. Although green finance is embedded in the system, its role is still reactive. The TCI being just under 50% signals that while green finance is growing, it has not yet surpassed the influence of conventional finance.

The spillover dynamics offer insufficient evidence to confirm a crowding-out effect of traditional investments by green finance. The expectation of green finance as a dominant shock transmitter is not supported; instead, green finance is shaped by traditional finance. The dominant volatility transmission from trade returns to green returns suggests that green finance is still largely influenced by traditional markets, rather than driving independent trends. These findings highlight that green finance, while growing, remains subordinate to conventional investments in China's financial system. The moderate TCI indicates integration, but the negative net spillovers confirm its dependent position. For deeper insights, the rolling total connectedness index is plotted.

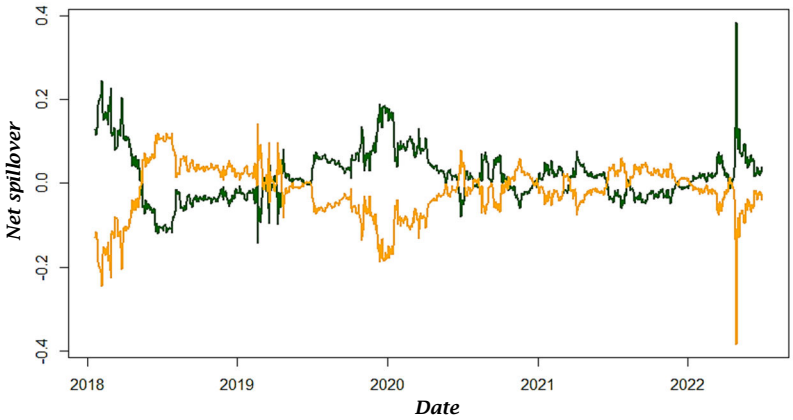
Figure 1. Plot of rolling total connected index



Source: Authors' elaboration.

The rolling total connectedness index plot shows the changing spillovers between green and traditional financial returns from 2017 to 2024. The rolling total connectedness index, expressed as a percentage, measures the degree of interdependence between the two returns. It is observed that throughout the period, the TCI stays between 49.4% and 49.9%. This reflects moderate connectedness only from 2018 to mid-2019. The total connectedness index increases, which suggests growing market integration. This growing integration might be due to rising institutional awareness and sustainable policies. However, between 2020 to 2021, the TCI dropped most probably due to the COVID-19 pandemic disrupting capital flows. The recovery in 2022 is observed, and an increase in 2023 to 2024 suggests renewed policy support and a stronger green finance participation. The consistently high TCI indicates a strong link between green and traditional finance. This also indicates that both markets are interdependent. The TCI trend does not show evidence of crowding out, but it signifies mutual dependency. This is important for analyzing dominance through further spillover analysis. These findings show that systematic connectedness is stable but responsive to external events and policy shifts. The rolling net spillover plot tracks volatility transmission between green and traditional finance from 2017 to early 2022. The net spillover index shows whether a market is a net transmitter or receiver of shocks in the early stages. Until 2019, the traditional investments are net transmitters, while green finance is a net receiver. This demonstrates green finance's earlier position as being in the developing phase and influenced by conventional market trends. However, from mid-2019 onwards, green finance shows positive net spillovers, which indicates its increasing influence, likely due to the rise of ESG investments and ongoing demand for climate-focused financial products.

Figure 2. Rolling net spillovers



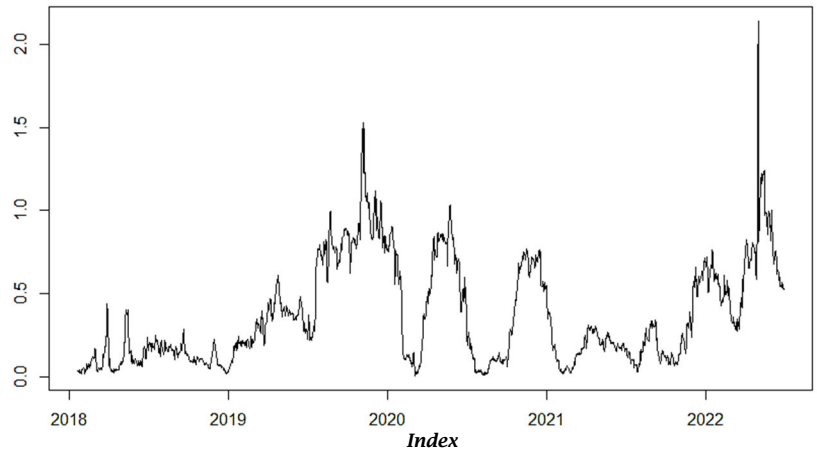
Source: Authors' elaboration.

The net spillovers graph displays greater volatility and alternation between 2020 and 2021. The green series is for (*green_returns*), and it shows periods of net dominance. We noticed that it often crosses above zero. This indicates the phases where green finance temporarily became a systemic driver of financial spillovers. These transitions could be attributed to macroeconomic disruptions such as the pandemic and post-pandemic recovery measures. An extraordinary spike in early 2022 is observed where green returns sharply rise as the dominant net transmitters. On the other hand, traditional returns plunge into negative territory. It implies a possible shock event likely related to geopolitical or policy-driven disruptions that led to a rapid reallocation of market attention toward green sectors. This episodic spike demonstrates that green finance, although it is not yet structurally dominant but can momentarily lead the system, particularly in times of uncertainty or sector-specific momentum.

Over the longer term, the rolling pattern shows a net positive balance between the two return series. The green finance no longer appears structurally subordinate as it did in 2018–2019. It also does not consistently maintain dominance here. Instead of this, the plot reveals a transitional relationship. The green and traditional finance are observed in exchanging roles as net transmitters depending on broader market conditions. This nuanced behaviour suggests that green finance is emerging as a co-equal systemic force and capable of influencing traditional investment behaviour. But the observation is not yet robust enough to support a strong and sustained crowding-out effect.

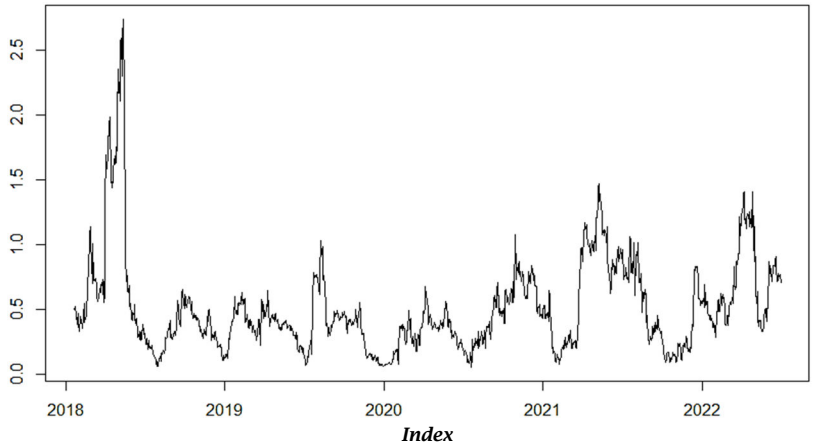
The findings can maintain that the rolling net spillover results provide empirical support for the gradual maturation of green finance within Chinese capital markets. The green instruments have not achieved permanent dominance, but their increasing role as intermittent transmitters of systemic shocks suggests a shifting balance of influence. Figures 3 and 4 present the spillover analysis through the BK frequency domain framework.

Figure 3. Short-term analysis: Overall spillover bands (0.785,3.14)



Source: Authors' elaboration.

Figure 4. Long-term analysis overall spillover bands (0.000, 0.785)



Source: Authors' elaboration.

The frequency-domain analysis using the BK decomposition clearly distinguishes the spillover behaviour of green and traditional financial assets across short-term and long-term periods. In the short term, the spillover graph shows that from 2018 to 2019, the interconnectedness between green and traditional assets remained low and it remains relatively stable. This suggests a lack of immediate volatility transmission between the two markets. These dynamics changed sharply with the onset of the COVID-19 pandemic in early 2020, when short-term spillovers surged above 1.5. This rise shows that green financial instruments began reacting almost in real time to global financial shocks. It means that their integration and exposure to systemic risk have increased. The most pronounced spike appears in early 2022. We can relate it to geopolitical instability and energy market disruptions. It implies that green assets have become fully reactive to macroeconomic developments, including non-environmental shocks. In short, the short-term movements demonstrate that green finance is now actively participating in high-frequency financial cycles. It is influenced by investor sentiments, media-driven speculation, and short-horizon policy announcements.

Contrary to that, the spillover graph for the long-term reveals a more structural and gradual pattern of integration. After a sharp rise in 2018, probably due to new policy changes and global climate agreements, the long-term effects became more stable and stayed at lower levels until 2020. From that point onwards, there was a steady rise in long-term connections. Several high points were seen during 2021 and 2022. The upward trend implies that green finance is becoming an integral part of the broader financial ecosystem.

Our findings align closely with several key studies. Peng et al. (2023) observed the increasing influence of green finance during market volatility, which matches our observation of green finance's growing impact on traditional markets in times of crisis. Similarly, Belguith (2025) emphasizes the role of green finance, particularly green bonds, in risk management during market stress, which is also consistent with our findings. Additionally, our results also aligned with Khalil and Nimmanunta (2023) about the competitive coexistence of green and conventional finance.

5. CONCLUSION

This study empirically investigates whether the rise of green finance leads to a crowding-out effect on traditional investment. By applying the DY spillover framework and the BK frequency decomposition approach to a dataset of green and traditional financial returns of Chinese firms for the time spanning 2017 to 2024, the analysis provides an understanding of how green financial instruments interact with, influence, and are influenced by conventional financial markets across different time horizons.

The DY spillover matrix revealed moderate interconnectedness, with nearly half of the system's volatility that is explained by cross-variable interactions. While initial spillover results showed symmetry between green and traditional investments, further analysis showed that traditional investments primarily acted as net transmitters of volatility, especially in the early period, while green finance was mostly a net receiver, and thus accepting *H1*. Directional analysis revealed moments when green finance began asserting more influence and occasionally acted as a net transmitter. These shifts suggest that green finance is gaining significance. Although not yet fully replacing traditional investments, and not yet consistent, suggesting accepting *H2*. The rolling spillover analysis confirmed this by showing increasing short-term sensitivity and directional shifts. This is more visible, particularly during events like the COVID-19 pandemic and geopolitical crises. The BK frequency-domain analysis signifies that green finance's volatility transmission grew after 2020, with sharp spikes in 2022. This indicates that it has greater integration with market sentiment and short-term shocks. Long-term trends depict green finance becoming more integrated into strategic investments such as pension funds and ESG portfolios, and thus, *H3* is also accepted. The finding that firms are increasingly allocating their capital to green finance is aligned with financial intermediation theory. Portfolio rebalance hypothesis alignment is also observed as investors rebalance their portfolios during times of risk. Overall, these outcomes demonstrate that green finance is evolving into a more influential market

force but not yet crowding out traditional investments. Instead, the two sectors appear to be evolving simultaneously.

Based on the growing interconnectedness between traditional and green financial markets in China, the study provides the following recommendations. Firstly, strengthening the regulatory framework for green finance is of crucial importance. It includes standardised taxonomies and ESG disclosure requirements. Additionally, given the increased volatility in short-term spillovers, regulators should improve risk management tools. For instance, climate stress testing and forward-looking volatility models in green assets. Furthermore, policymakers should support balanced capital allocation. They should promote transitional finance for high-emission industries to adopt cleaner technologies. Incentives like long-duration green bonds, tax benefits for ESG portfolios, and ESG mandatory requirements for pension funds should be introduced. Enhancing financial literacy will reinforce the green finance role in China's economic future.

Although the study provides valuable knowledge about the spillover dynamics between green and traditional financial sectors in China, it is not free from limitations. The analysis in this study is limited by the availability and quality of green finance data. It focuses only on equity stocks. Including data on green and traditional bonds and other instruments could improve the robustness of the results. The short time frame and emerging nature of China's green financial instruments impede the understanding of the long-term shifts and cyclic behaviors. Focusing only on aggregate sectoral indices may overlook specific sector differences. It is possible that traditional sectors may react differently to green finance development in different sectors. In addition to that, while the DY and BK models are effective, they still assume a linear relationship and may omit nonlinear dynamics in feedback loops. Finally, the findings are specific to China and may not apply to markets with different financial and regulatory infrastructure. All these limitations can be addressed in future studies.

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