Original Research Article

Impactof Financial Support on Transforming China's Energy Economy

Abstract

Improving the energy sector and expanding the use of renewable energy are crucial to China's efforts to combat climate change. Finance-related problems, which are inextricably linked to China's financial growth, are one of the major obstacles to its energy transformation initiative. It is crucial to comprehend the extent that China's financial success impacts the growth of renewable energy sources, and even more crucially, which components of that development are vital. China's accelerated move into a digital economy has created new prospects for the green economic sector's advancement. This research presents convincing proof demonstrating that financial progress is crucially significant and generates a total of 42.42% to the variety of green energy growth via an assessment utilizing macro-level data. The paper employs the time series based analysis with the vector autoregressive model (VAR) to make a comparison between past and current observations of the variables. The study’s findings comprehensiively demonstratespolicy analysis, forecasting and data description relating to China’sfiscal ability to transform their energy economy through a significant approach such as green finance. In particular, we can show that the capital sector is the single most crucial element, then foreign investment. Simple comparisons between the EU and US situations show that the EU approach is more pertinent therefore Chinese authorities should pay closer attention to it.

Keywords: renewable energy,financial development, energy economy, green finance

1. Introduction

1.1. Background

Today, the topic of energy consumption and energy efficiency is of global interest, as worldwide nations seek to conform to climate change initiatives and greenhouse gas (GHG) emissions policiesto reduce the adverse impacts of global warming. With energy consumption levels at the centre stage of climate change, China emits about 27% of the global GHG, a third of the global emissions. In an initiative to control this, the country has installed hydro, wind and solar power to generate energy. Still, it generates 26% of its electricity from renewable energy sources from fossil fuels, accounting for approximately 90% of the nation's energy use (Ali et al., 2018).

Burning fossil fuels, primarily coal, causes a lot of pollution in the atmosphere and is the primary contributor to China's greenhouse gas (GHG) emissions. According to data from the World Resource Institute, China and the U.S. are the two countries that generate the most greenhouse gases globally. Together, these nations account for over 30% of all global GHG emissions. On the 12th of November 2014, the heads of state of these nations signed a landmark agreement to work together to decrease emission levels in response to mounting pressure brought on by the possibility of global climate change. China has committed to reaching its peak carbon dioxide emissions in 2030 and increasing the proportion of energy derived from alternatives to fossil fuels to about 20% by that time. However, it is still uncertain whether or not the policies and measures will be able to attain such a lofty objective without having an impact on economic performance.

China's economy is highly dependent on the global energy market, particularly the global crude oil market, which accounts for over half of its total consumption, yet another related concern. The economic performance of China may be significantly impacted by instability in the global oil market, particularly recent price changes and wars in the Middle East. For Chinese policymakers, energy safety and the contribution of energy to sustained economic expansion have taken on significant importance. Because the energy industry is so strategically important, China's government is under pressure to fulfil the nation's interests in protecting the environment and energy security. As a result, they are thinking about how to modernize the energy generation and consumption framework.

Notably, there appear to have been the following two significant shifts from the standpoint of financial development. First, the financial department supports the development of diverse sectors more directly and efficiently by providing the necessary financial resources. Second, the financial market framework will be substantially streamlined, and the level of direct financing will significantly rise. It is also concerned that resource depletion will occur over time due to the dependence on rapid expansion. Before the "new normal" phase, the Chinese economy grew at a breakneck pace for a considerable period, with energy consumption rising as an essential productive input(Ali et al., 2018). This stage denotes the quick switch from an unsustainable form of economic development. However, the economic development pattern should change from overall progress to intense expansion according to the framework of the new normal. The energy industry's tasks include streamlining the energy use structure and establishing clean, contemporary energy systems as the new norm to meet the demands of intensive expansion. Therefore, increased financial resources should support the monetary system and energy transformations. The development of the old energy business was formerly

endorsed more frequently by China's commercial lending institutions than that of the new energy sector. Therefore, more financial support is anticipated for the new energy sector, which is essential to improving the energy structure.

This paper is structured as follows. An overview of previous research on economic development in factor categorization is presented in the second section. The methodology and data collection methods for quantitative and qualitative information are described in the third part. The econometric techniques for data analysis are introduced in the fourth part. The empirical findings are highlighted and discussed in the fifth part. The last part concludes the paper and suggests relevant policy implications for stakeholders and decision-makers in China.

1.2. Research Questions and Objectives

This study's primary objective is to unravel the effectiveness of pulling financial support to transform China's energy sector and make it more sustainable and efficient now and in the future. Research questions for this paper are outlined below.

- What is China's energy economy, and what are the main factors that make it need transformation?
- How can the Chinese government mobilize local and global financial partners for their economic and capital support for the country's energy transition?
- What financial resources are currently available to support China's energy transformation efforts, and to what extent are they sufficient to meet the needs of this energy transition?
- Which forms of financial investments are essential, and how much can they help foster the growth of renewable energy?
- What are the potential economic and environmental benefits of transitioning to a more sustainable energy economy in China, and how can these benefits be maximized?

- What are the key government policies and incentives in place to promote the transition to a sustainable energy economy in China, and to what extent are they effective in achieving this goal?

On the other hand, the following research objectives are answered in-depth in the rest of the paper.

- To investigate the current state of China's energy economy and the factors that make it ripe for transformation.
- To evaluate options through which the country can mobilize local and global financial partners to obtainfinancial resources for the country's energy transition.
- To identify the financial resources currently available to support China's energy transformation efforts and assess their adequacy.
- To find out the forms of financial investments that are important and the amount required to help foster the growth of renewable energy.
- To explore the potential benefits of transitioning to a more sustainable energy economy in China in terms of economic growth and environmental sustainability.
- To examine the role of government policies and incentives in promoting the transition to a more sustainable energy economy in China and assess their effectiveness.

1.3. The Rationale for a Mixed-Method Approach

For this study, a mixed-method approach is a logical choice for several reasons. First and foremost, the mixed-method system enables the fusion of both qualitative and quantitative information to offer a more thorough and complex knowledge about the challenging problem of China's changing energy economy. With only one approach, this strategy may make spotting patterns, trends, and complex relationships easier. Additionally, by gathering data from many

sources, the mixed-method technique can help to improve the accuracy and legitimacy of the study's outcomes. This is crucial when researching a subject as intricate and multifaceted as China's changing energy economy, which calls for various viewpoints and data kinds. By integrating quantitative data with qualitative stakeholder perspectives, which can then be studied jointly, combining these methods can offer a more comprehensive knowledge of the problems at hand. This method can assist in identifying potential conflicts or disparities between stakeholder opinions and quantitative data, which can subsequently be handled and resolved.

2. Literature Review

2.1. China's Energy Economy and Financial Market Development

A rising worldwide consensus favours the development of alternative energy sources to reduce the worldwide usage of fossil fuels owing to the risk of global warming brought on by GHG emissions. Although the use of renewable energy is expanding in an accelerated pace, it still only accounts for a small portion of the global energy consumption. In recent years, numerous scientific research has appeared to model the growth of renewable energies. These research efforts seek to determine the factors that influence the advancement of clean energy sources and the relationships between the establishment of these green energy sources and various fiscal and economic factors, such as energy pricing, emissions, economic expansion, and financial viability (Acheampong et al., 2020). Many scholars and energy experts have previously examined the connection involving economic development and the elements discussed in this research. Compared to this study, their conclusions can show the drivers of economic growth in China and other nations during the same period.

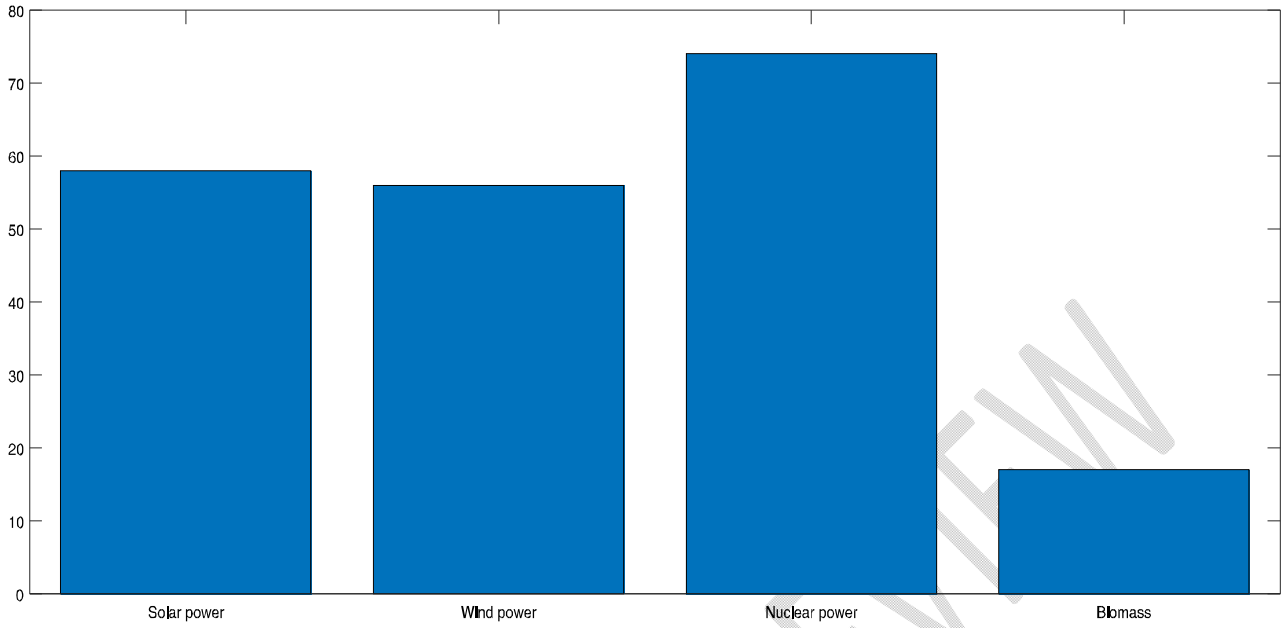

Figure 1: Showing Different Renewable Energy Use in China

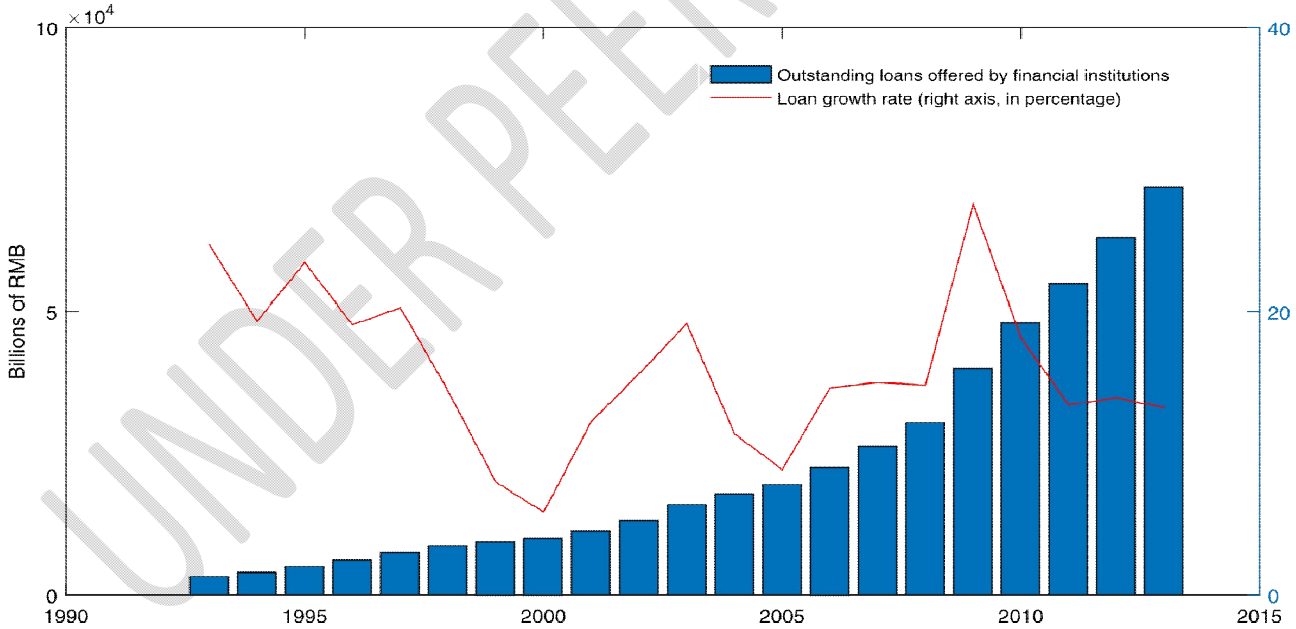

Figure 2: Illustration of the Rise of Domestics Loans by Lending Institutions

The capital market for financing places heavy restrictions on the growth of renewable energies. The cost of finance for the needed architecture substantially impacts financing, even

though investments in renewable energy projects have recently increased. Most recently, this argument has drawn several studies that seek to define the part that financial development plays in the widespread use of renewable energy (Dreher et al., 2021). The significance of the energy sector and environmental issues was emphasized by Creti and Nguyen (2018),who also identified several obvious obstacles to policy in the years following the Paris Agreement. The Paris Agreement's economic effects or financial market implications have been identified as the primary concern amongst other existing variables. The East Asia Summit territory was a focus of Changet al. (2016), who also highlighted the importance of fiscal policies in fostering the renewable energy economy. Their project and compilation of relevant studies established unambiguous claims on the policy significance of financing in facilitating the transition to renewable energy (Xie and Zhang, 2023). In this view, the growth of the financial market is essential, and sound policies and system design are required to guarantee an optimal setting for environmentally friendly energy investments.

2.2. PreviousStudies

Various research has determined that financial development causes and positively influences economic growth. Generalized moment method (GMM) analysis byChiu& Zhang (2023) of dynamic panel data from 71 nations between 1960 and 1995 stated that financial development favoured economic growth. Another study by Chang et al. (2016) included 74 countries and confirmed the contribution of financial development to economic growth. However, the study by Chang et al. (2016) failed to demonstrate how financial product contributes to economic growth despite using 19 periodic figures from 19 OPEC nations and China. On the contrary, the number of national research on economic growth has increased recently.

A nationwide investigation makes it simpler to choose variables based on the characteristics of the banking sector and indicates the amount of financial development than a cross-country study does.The significance of establishing a solid and reliable financial base that influences transformations in China's energy consumption structure is a contemporary issue for discussion. For instance, Chiu & Zhang (2023) demonstrated how China could enhance its energy consumption structure by reducing incentives for coal or oil using a Computable General Equilibrium (CGE) model. According to their modelling results, reducing coal subsidies by 3% resulted in a 1.76% rise in the percentage of non-fossil fuel energy relative to the baseline scenario. Doytch and Narayan et al. (2016) looked at the long-term relationship between economic growth, funding, commerce, and energy consumption in China using many financial stability measures, including foreign direct investment (FDI) inflow, stock market enhancements, and the banking sector. According to their empirical findings, economic development was expected to increase the energy demand, which contributed to increased emissions and fossil fuel reliance. Long-term, China ought to invest more money in green energy sources to increase the country’s overall efficiency in energy production (Zhou et al., 2020).

From the aforementioned investigations, China has come to a different result. Preliminary research was done on the Granger causation involving economic growth and development in China, where Chiu & Zhang (2023) utilized data from 286 Chinese towns between 2001 and 2006 and discovered a favourable relationship between financial development and economic growth. Another research by Ernst & Young (2016) used the GMM approach to analyze provincial panel data for China from 1985 to 1999 and discovered that intermediary financial services in China increased savings among homeowners and state budget replacements, and also stimulated the economic growth. However, it is believed that the ineffective loan dispersion by

China's financial institutions is why the rise in loans failed to spur economic growth (China Securities Regulatory Commission, 2016). Jianet al. (2019) discovered that the loans had a detrimental effect on per capita GDP. Kim& Park (2016)made an analysisusing China's provincial panel data from 1989 to 2003 and concluded that the amount influenced by capital financing boosts economic growth while the degree of government interference in financing has a detrimental effect on economic growth. The GMM approach was used by Hao et al. (2016) to evaluate the province panel statistics from 1995 to 2012 and discover the adverse impact of financial development on economic expansion. As was already established, some empirical studies supported China's financial development's contribution to economic growth. Conversely, several studies have concluded that dueto China's inadequate financial distribution, the financial product has little effect on the country's economy and might hurt it.

Jian et al. (2019) investigated the factors that influence the usage of green energy in six significant growing economies, particularly China. Their empirical findings imply that wealth and pollution levels are the key variables affecting renewable energy use in China and that there is a short-term bidirectional relationship between them (Wang & Wang, 2021). These conclusions are based both on panel-data models and time-series models. Their analysis of the available research revealed that when researching this topic, academics typically adopt either the supply-side or demand-side techniques (Ji and Zhang, 2019). From the evaluation, while the demand-side analysis used carbon dioxide emissions, energy costs, and income, the supply-side studies employed manufacturing capacity and technological advancements.

For instance, to determine the direct cause-and-effect relationship between green energy consumption and economic growth in Organization for Economic Cooperation and Development (OECD) member states and a broader sample of 80 countries, He et al. (2019) used panel time-

series simulations. Chen et al., 2019 extension of their earlier model for the panel integration approach supports a nonlinear, seamless transition technique. According to empirical findings generated from annual data for seven Central American nations from 1980 to 2010, economic growth, energy prices, and emissions had substantial longer-term effects on energy consumption from renewable sources (Kimura et al., 2016). In their analysis of 20 OECD nations from 1990 to 2008, CAIT (2017) discovered a unidirectional causal association between the production of renewable power and an increase in the country's gross domestic product (GDP). Still, the strength of the link varied depending on the energy source.

2.3. Research Gaps

The available literature generally demonstrates the growing interest in advancing the exploration of renewable energy. The impact of financial growth has been established, although mainly in a few nations. Consequently, this research, to start with, are not unique to China. China is the frontrunner regarding investments in renewable energy, as mentioned. China's leadership stresses the need for continued advancement in renewable energy to create a green financial system. Which forms of financing are more critical, and how much can they help foster the growth of renewable energy? These are the challenges facing policymakers. There are no clear answers to these queries in the extant literature.

These cross-country studies offer essential data on the factors that influence the progress of renewable energy, but they are not tailored to China's circumstances. Furthermore, most existing studies fail to simulate all markets as a system and instead concentrate on the supply or demand side. In practice, all the factors interact. The present research uses a systemic approach pertinent to China's need to enhance its energy structure over the time frame studied. An open system considers all the factors discussed in the research, encompassing the supply and demand

sides. By doing this, we can fill a gap in the literature and offer crucial knowledge to China's policymakers.

3. Methodology

To investigate the requirement for financial support to reform China's energy sector, a mixed-method research approach is used in this paper. Qualitative and quantitative methods are employed to give a more thorough grasp of the subject of the study. This study's qualitative component entails in-depth interviews and a sampling strategy with significant stakeholders. In contrast, the quantitative part entails a review of available financial data and statistical analysis.

3.1. Research Design

The model employed in this section is centred around the vector autoregressive model (VAR), which was first developed and has since been shown to be a very effective tool for examining relationships in a macroeconomic system. The VAR model offers a straightforward yet efficient method to explicitly define how economic components are linked or interact by enabling every variable to be inherent and integrating them into a structure. Yet, it can be challenging to interpret a VAR model. A VAR model contains far too many coefficients to be adequately explained. On the contrary, the model is frequently interpreted using a variance analysis and impulse response function. These two approaches are forward-looking. The variance decomposition technique offers details concerning how parameters in the system can understand the variation in a single factor derived from the prediction error. At the same time, the impulse response function illustrates how the entire framework reacts to specific disturbances.

3.2. Data Collection

This paper will gather the quantitative databy looking at secondary sources, such as academic articles, government reports, and other appropriate publications. A comprehensive assessment of the origins of data access will be part of the sampling approach to finding accurate and timely data crucial to the research objectives. Also, an in-depth examination of pertinent databases utilizing keywords or phrases about China's energy sector and the financial backing for environmentally friendly energy transitions will be part of the data gathered. Statistical techniques such as descriptive statistics will be used to examine the information obtained to find patterns and trends in the report.

On the other side, in-depth interviews with significant players in China's energy operations will be used to gather the qualitative data for this study. Purposive sampling, which entails choosing individuals based on their knowledge and experience in the sector, will be the sampling approach used. Government representatives, business executives, and academics with expertise in China's energy sector and the funding needed to alter it will be among the participants. Semi-structured discussions with the chosen participants will be conducted as part of the procedures for gathering information to learn about their viewpoints on the issues being investigated. This approach will be documented in audio and verbatim translated for further assessment. For this purpose, a translator will be available with familiarity with Mandarin.

The goals of issuing interview questions for this investigation are to gather information about the participants' opinions of the present condition of the energy economy in modern China,financial resources readily accessible for promoting the process of energy transformation, the potential advantages of an environmentally friendly energy economy, the difficulties and

obstacles in accomplishing a sustainable energy transition, and the strategies that can be used to overcome them. Thematic analysis, a process that involves locating significant patterns and trends in the data, will be used to examine the information gathered and to derive findings and recommendations. The themes are going to be reviewed and analyzed appropriately.

3.3. Data Analysis

The accessibility of information on stock markets in China will determine the yearly distribution of data utilized in this section that spans 1992 to 2013. Before 1992, there were no publicly accessible stock market data available. The variables used for this study were selected for the empirical model based on the literature. In addition, data from the National Bureau of Statistics in China and the CEInet Statistics Database are used as macroeconomic indicators for measuring financial development. It also incorporates data on GHG emissions from CAIT (2017) and is used to track environmental demands for using energy from renewable sources.

The three main measures of financial development are the stock market, the financial market, and overseas investment as a proportion of GDP, which have been employed following the existing literature. The prerequisites for both equity and debt funding are also represented. The third metric illustrates how foreign investment has affected the economy. The framework of energy utilization is represented by the percentage of renewable energy in the overall final energy consumption. The stability of this simulation will be further evaluated using non-hydro energy-producing net output.

The left-hand panel of Fig. 3 below shows the proportions of renewable energy in overall energy consumption and the net power produced from non-hydro renewable sources. The ratio of renewable energy in China's overall energy consumption grew during our sample, almost doubling from 5.2% in 1993 to 10.2% in 2013 (Hao et al., 2020). The most significant

percentage and the biggest difference from other renewable energy sources is hydropower. When hydropower is excluded, the patterns of net power production from clean energy sources vary. After 2008, when non-hydro power generation saw a strong surge, the illustration exhibits a distinct transition in structure. One must consider this, so we utilize developments in non-hydro renewable power net production as another factor for China's progress in renewable energy sources and its energy infrastructure to assess how reliable the statistical results are (Wang et al., 2021).

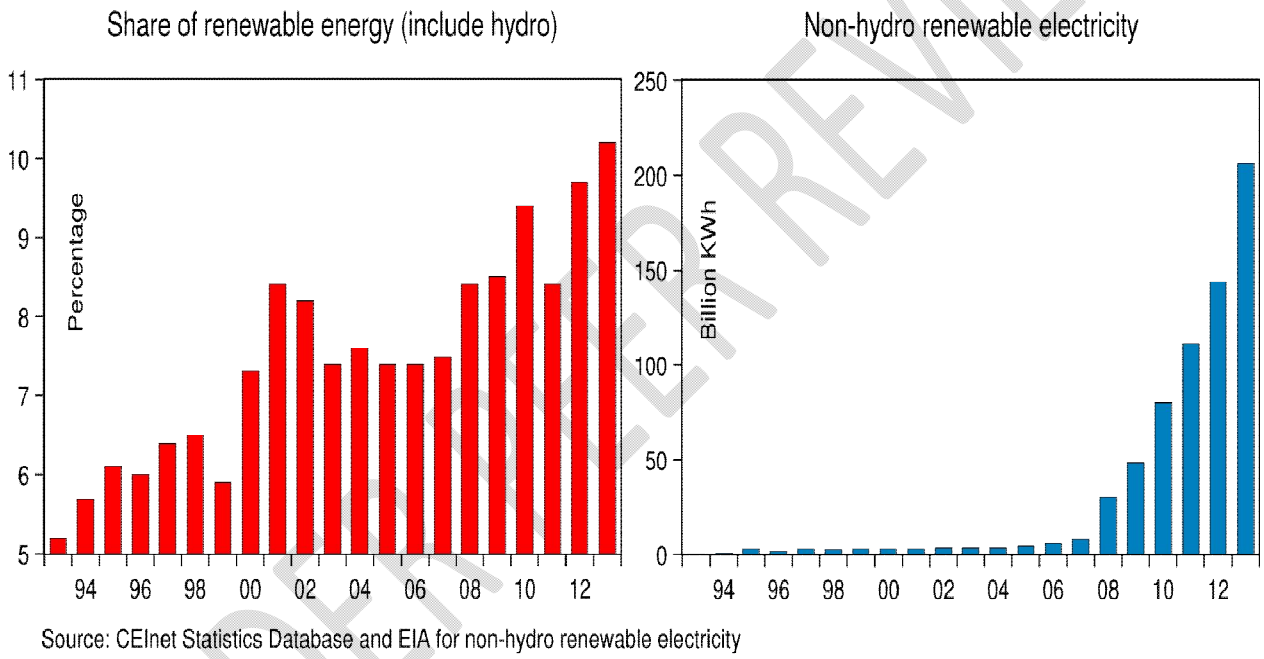

Fig 3: A Comparison of China's Renewable and Non-Renewable Energy Share

4. Results

4.1. Financial Development on Share Value

The energy framework in China is approximated using a seven-variable VAR model employing renewable energy as a percentage of overall energy consumption. When plotting a relationship in this system, pairwise comparative contributions among any two variables can be

used. The graph demonstrates that the stock market's growth plays a crucial role in the overall framework and is the major contributor. Nevertheless, the most considerable net benefit from the system is economic expansion, which also gains compared to what it does to all the remaining variables. The stock exchange and the lending market constitute net contributions to the percentage of renewable energy, one of the critical financial growth metrics. Variations in oil costs are another net factor affecting China's energy system.A different account of the system's operation has been provided. It details the extent to which one variable benefits from the framework alongside how much it impacts it. The net measure applies to where a stock makes the overall system's most significant net contribution (39.48%), and growth receives the technique's most significant net benefit (70.10%) (Chen et al., 2019).

4.2. Demonstration of Tables and Graphs

The illustrations in this section present the statistics of varying renewable energy sources and their consumption levels in the country. Furthermore, the framework shown in Fig 4 demonstrates how the seven components rely on one another.

Table 1Data statistics results

Statistics	Renew01	Renew02	Stock	Credit	FDI	GHG	Oil	Growth
Mean	0.25	44.78	1.73	1.24	− 0.13	5.85	8.22	9.29
Median	0.20	25.33	− 1.26	1.52	− 0.23	6.22	10.59	9.00
Maximum	1.40	273.34	80.32	19.54	2.40	13.08	47.07	13.60
Minimum	− 1.00	− 69.31	− 83.07	− 10.19	− 1.19	− 1.51	− 45.12	6.70
Std. Dev.	0.64	74.31	28.38	6.71	0.80	4.00	24.36	1.95
KPSS Test	0.07	0.17	0.11	0.08	0.22	0.14	0.12	0.09

From the above table, some generic empirical information on the variables that are employed in the economic model are presented. Every single variable shows a favorable mean growth rates during the whole study period aside from inflows of foreign direct investment (FDI). Given that FDI inflow rates are compared to the gross domestic product (GDP), a

negative result might merely indicate that GDP is expanding faster than the amount of FDI coming in. The expansion of the green energy economy is measured differently, which is also supported by Fig. 4.

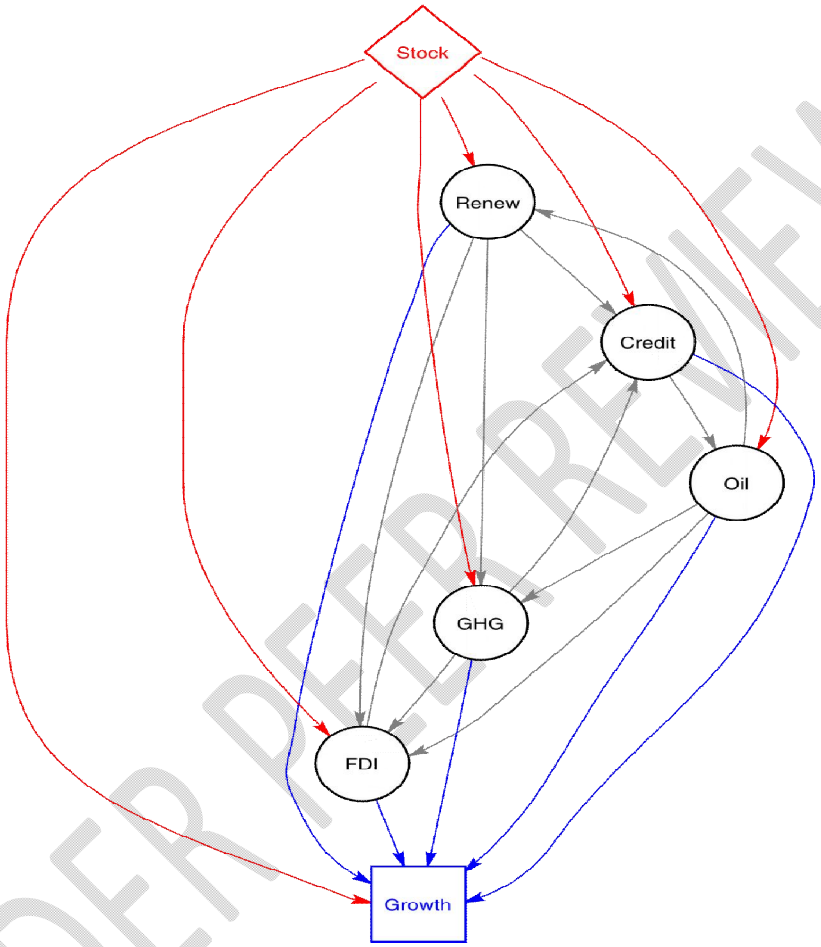

Figure 4: An Illustration of a Pairwise Interaction in the Energy Framework

The framework of China's energy consumption is approximated by incorporating a seven-variable VAR framework implementing renewable energy as a percentage of overall energy consumption. As shown in Fig. 4, the relationship between elements in the above structure can be portrayed through the pairwise relative contributions made by each of the variables.

4.3. The Case of China

The three key financial measures, stock, FDI, and credit, can be viewed as the supply-side variables in the growth of clean energy in China if both oil and GHG represent the demand aspect of doing so (Chen et al., 2019). The stock marketplace, which consequently makes up the most significant portion, accounts for 16.25% of the volatility in energy growth from renewable sources. The second factor is foreign capital investment. The empirical approach demonstrates that developing China's capital markets accounts for 42.42% of the country's energy efficiency progress over the last two decades (Paramati et al., 2016).

The clear takeaway from these empirical findings is that Chinese policymakers support financial development and implement additional favourable financing regulations for renewable energy. Our results offer solid statistical support for recent efforts in China to advance the development of a green finance system (GFT Force, 2015). We utilize a different measure to depict the modifications in China's energy system to test the validity of the empirical results presented in the preceding section. In this instance, the expansion rate of renewable non-hydro electrical power generation is utilized. The largest source of clean, renewable energy is hydropower. Its evolution nevertheless possesses particular features that set it apart from other renewable energy sources. It has an uneven geographical distribution, with the greatest concentration in southwest China. Its expensive electricity distribution from these areas to eastern China also comes with increased development costs in those power-rich areas. Then, hydro projects are frequently substantial and call for significant public funding. Additionally, the authorization process is drawn out and might encompass numerous government departments. Even if it resolves some environmental issues, it may create new ones.

Because of the unique qualities of hydropower, non-hydro power is a more crucial area for energy structure reform. In actuality, non-hydro-renewable development already plays a more significant part. Since 2008, the non-hydro portion of renewable energy has significantly expanded. We must figure out how well our econometric system functions without hydropower. The rate of increase of non-hydro energy sources is estimated instead of the proportion of growth in renewable energy employing the VAR technique.

5. Discussion

5.1. Interpretation

The US and EU are two of the global leaders in both the implementation of and funding green energy, thus it is important to analyze what transpired in both of these economies. He et al. (2019)made use of data from the World Bank, which covers both of them from 1991 and 2012, which is almost a similar time frame as for China. When the previousempirical results werecompared to nations such as the United States and Europe, the outcomes were quite distinct from those in China (He et al., 2019). Only 22.57% of the US share of renewable energy was attributable to financial development, compared to 33.78% for oil fluctuation in prices alone. It is illustrated by Liu et al. (2019) that economic reasons weigh far significantly in the EU market, where its contribution to the sustainable energy market totalled 56.02%. We find this percentage to be comparable to that of China, although credit, not the stock marketplace, is the primary driver in the E.U. market. The contrasting significance of economic development is a further difference between the E.U. and China. While development makes a negligible contribution to sustainable energy growth within China, it makes up about 16.76% of it in Europe.

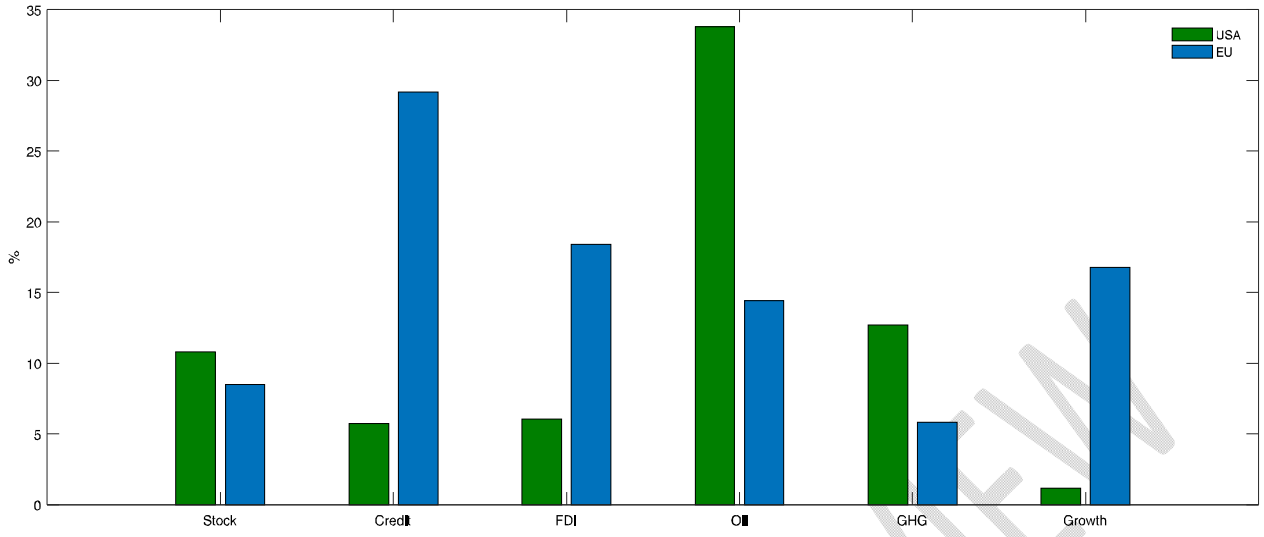

Figure 5: The US and EU Share Value of Renewable Energies

From the above illustration, the credit sector in China appears to be playing a minor role (about 14%) compared to that of the EU which is about 30%. On the other hand, the share for the U.S credit sector is valued at 6%. This variable alone shows the discrepancies between the US and EU. Bai et al. (2019) concludes that despite the goal of creating a green banking system and some significant banks' actions have rendered a message to the market, it is uncertain how the framework may benefit SMEs. Regarding the significance to financial development, China and the EU are somewhat comparable, although China and the U.S tend to be quite distinct. Given that China and the EU share more basic traits than the US, the EU route might prove more applicable to China.

China will approach these two developed markets gradually. The findings presented unmistakably show that the Chinese path is more similar to the E.U. model than the U.S. history. Given that the U.S. has maintained the biggest and most advanced financial sector for over a century, this is not altogether unexpected. In contrast to China and the E.U., whose economies

depend significantly on the world's energy market and experience more significant energy limitations, it additionally possesses a wealth of natural assets.

5.2. Policy Implications

The empirical findings have several obvious policy ramifications. First, our results demonstrate that China has a market mechanism to assist the green transition. Like other industries, renewable energy production may greatly benefit from expanding financial markets. With improved efficiency and reasonable financing options, stock market growth and credit system reform can indirectly help the development of renewable energy sources. International investment in the field of renewable energy should additionally be supported. Second, there is a need for explicit policy actions, particularly for the lending market. In China, the credit industry continues to perform a minor role compared to the European Union.

The concept of creating an environmentally friendly financial system and the actions taken by a few large banks have provided an unmistakable signal to the market. However, it is uncertain whether the framework could help small and medium Enterprises (SMEs) that are the most dynamic and significant forces for sustainable growth. Third, China looks like it differs significantly from the U.S. but exhibits some parallels with the E.U.regarding the significance of its economic growth.

Given that China and the E.U. share broader traits than the U.S., the E.U. route might be more applicable to China. Regarding the data's availability, the amount of data we have is relatively modest overall; as a result, the numerical findings shouldn't be overanalyzed because they could be subject to any significant discrepancy in the variables. The overarching message should, however, not change. This in-depth investigation of past information in China has a clear message for policymakers: they ought to reinforce the significance of the financial sector and

create laws that support the renewable energy industry more. It further provides evidence of support for the demand for China to create an environmentally sustainable finance system.

A more significant overhaul of the financial system is required to make it simpler for non-state-owned businesses to get loans. Government should refrain from interfering with commercial banks to misallocate financial resources and disburse loans to companies that are not productive. Therefore, it is essential to continue enhancing the financial system's functionality and the market's. Also, think about the relationship between real GDP, consumption of energy, and capital stocks. China's economy is currently facing the transition to a future industrial phase. The strong relationship between GDP, energy use, and the amount of capital needs to be considered when the nation develops its energy consumption strategy. For instance, the decline in energy consumption directly impacts economic development and a secondary effect via lowering capital stocks. In the meantime, securing energy availability, its advancement, and using new energy technologies is essential.

5.3. Limitations andFuture Research

The distinction between the duties of the federal and local governments is a difficult one in the energy industry's reformation process. While the federal government has lost the capacity to enact rules and make policy decisions, China’s provincial authorities have progressively strengthened their control over energy businesses. Local governments typically hire regulatory workers at the local level, but they do so to carry out rules set by the national government. There is a lack of clarity on the legislative and administrative responsibilities of the State Council's numerous commissions and local government organizations (Secretariat, 2018). Some people find it difficult to relinquish their duties and battle over resources. The ineffective execution of safety standards and removing unlicensed mines due to concerns between local and federal

governments are two clear examples. The Chinese government must therefore establish an explicit set of regulations for the energy industry. It has been suggested that China adopt the federal system used in the U.S. and Canada, where local agencies and the federal government's local regulatory rules, such as those governing security requirements and interprovincial matters, have been clearly stated and upheld. It may also be thought about creating a single regulatory body to oversee all energy-related issues at the national and provincial levels.

At the corporate and commercial levels, the structure of governance issues ischallenging. Considering the current restructuring of the energy sector, it is unclear how free state-owned energy businesses are to compete domestically and abroad. For instance, it is unclear whether local oil corporations can use acquisitions and mergers to expand into the regions of other businesses. Additionally, domestic oil corporations lack clear governmental direction regarding purchasing overseas assets. Energy executives may behave most beneficially to the detriment of the public interest due to the lack of established anti-monopoly rules and regulations for mergers and acquisitions. It is feasible for both domestic and foreign competitors to collude or work together. Monopoly power can readily arise without a defined institutional structure that clearly defines the ability of regulatory authorities to control competitiveness in the renewable energy market.

The associated implications that we discovered are as follows. Firstly, governments should establish tax reductions and financial incentives to encourage a more significant share of green power in overall energy use to reduce CO2 emissions and protect the environment(Tian et al., 2022). Secondly, distinct financial development factors have varying impacts on CO2 emissions. Whereas governments should support the growth of the banking industry and stock market to encourage economic expansion, they ought to establish suitable financial market

policies, which include enabling more funding to adopt green innovations, which could lower energy use and carbon dioxide emissions. Thirdly, countries should focus more on increasing the share of green energy while supporting financial growth associated with decreasing emissions, as differing degrees of economic growth may impact the contribution of renewable energy sources to CO2 emissions(Li et al., 2022).

6. Conclusion

6.1. Key Findings

China's thirteenth Five-Year Plan (FYP) reiterated improving the energy sector's infrastructure as a potentially significant growth direction. Specific goals and actions have been developed to enhance the share of energy from renewable sources and encourage the production of clean energy. They represent the Chinese government's objective of lowering emissions and pursuing a sustainable and healthy course for economic expansion. Despite intense financial pressure, significant progress has been accomplished in the previous two FYP years concerning attaining ambitious carbon reduction targets.

Renewable energy development is frequently dangerous and expensive, particularly at first. Legislative support is required to foster an atmosphere that will help this industry grow. The economic environment is one of the most crucial pillars. The present research employs time-series information as well as a recently established systemic approach to examine how much the financial sector has played in the expansion of clean energy in China across the past 20 years, complying with the current research and China's recent developments on setting up an environmentally friendly financial system, that asserts that economic growth plays a crucial role for promoting renewable energy.

6.2. Significant Contributions

Our empirical findings demonstrate that the banking industry dramatically contributes to changing the framework of the energy sector in China, employing the expansion of the stock market, the growth of the credit market, and the growth of foreign investment as indices of financial development. More than 40 percent of the disparity in the variations in the percentage of renewable energy is often explained by the development of the financial sector. The continued growth of the stock market as a whole is the most significant of these economic drivers. It is compatible with the nature of an emerging sector's development, which is frequently risky and necessitates equity funding more than debt financing. We corroborate our findings and demonstrate the robustness of the results by utilizing the increasing rate for non-hydro hydroelectric net production as an alternate measure.

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