Resources Policy 91 (2024) 104903

Contents lists available at ScienceDirect

Resources Policy

journal homepage: www.elsevier.com/locate/resourpol

Nexus between fintech, green finance and natural resources management: Transition of BRICS nation industries from resource curse to resource blessed sustainable economies

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ARTICLE INFO

Keywords:
Natural resources extraction
Financial technology (fintech)
Resource curse theory
Dutch disease theory
BRICS nations

ABSTRACT

This article offers a comprehensive overview of the rapidly expanding literature on the resource curse phenomenon, in which nations wealthy in natural resources (such as the BRICS) have slower rates of sustainable monetary growth compared to those with less natural resources. This study lays the groundwork for the future of green finance by creating a theoretical basis for the application of fintech to the financial sector. Furthermore, the current research study contributes a fresh paradigm to the natural resource curse literature by exploring the investment and real exchange rate channels, by which green investment and green financing help to alleviate the resource curse. The study proposes a decision-making framework for executives in resource and non-resource sectors subject to the governments of BRICS nations. The research shows that if BRICS nations increase their green investment, they may break free of the resource curse that has plagued them. Findings also show that the development of highly competitive green goods and practices may impede real exchange appreciation, which is consistent with the Dutch disease theory (DDT). The results show, in the end, that the divergent policies of BRICS countries, based on Resource curse theory (RCT) and DDT, would steer enterprise managers towards attaining resource benefit together with sustainable social welfare objectives. Present findings from the study will steer the banking sector strategies to optimise the loan allocation of cash schemes while enabling assessment and supervisory initiatives for coordinating the green transition and strengthening amongst sectors (resource and non-resource). In order to direct the green development of the financial sector and services into the actual economy, green finance policies must be updated and put into practice on a frequent basis. Finally, the current study's management implications include directing industry strategies towards sustainable economic development where the elements responsible for unsustainable economic growth are identified using RCT and DDT.

1. Introduction

The sustainable development of resource-based nations is jeopardised by the widespread discovery of natural resources (minerals, oils, and gases) and growing reliance on them. The 'resource curse', which refers to the negative effects that might result from poorly managed extractive industries, has been common in recent years. The International Monetary Fund (2012) expresses concern about excessive reliance on natural resources and urges more efforts to break free of this "curse" via sustainable management of these assets. Different theoretical methods and scientific viewpoints have been discussed for over 30 years about the natural resource curse ("paradox of abundance") (Adams et al., 2019; Badeeb et al., 2021). The concept indicates that a country's economy expands more slowly if it relies too much on revenue from rent on natural resources (Shao and Yang, 2014). Resource rents are also an important source of revenue for economies that are endowed with large supplies of natural materials. To distribute resource rents to the sustainable business zone however, a robust and efficient financial system

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https://doi.org/10.1016/j.resourpol.2024.104903
Received 21 October 2023; Received in revised form 22 January 2024; Accepted 6 March 2024
Available online 21 March 2024

is required (Zhang and Brouwer, 2020). If natural resources aren't managed properly, they may cause economic inequality and environmental damage (due to unsustainable development initiatives). As a result, there is less overall economic and sustainable growth and more corruption than in countries with less natural resources. Also, governments and private citizens are more likely to waste money on "Unproductive investments" (Gylfason, 2006) when resource rent is simple to acquire. The phenomenon known as the resource curse may manifest itself via the occurrence of the "Dutch disease", when a country's currency experiences an appreciation, resulting in a loss of competitiveness in its export sectors. Consequently, this leads to a reduction in domestic output across many industries such as manufacturing, agriculture, and other sectors unrelated to natural resources. Consequently, this loss of international competitive advantage results in a diminished ability to compete globally (Badeeb et al., 2023).

According to Van der Ploeg (2011), "resource-rich countries with high investments in exploration technology seem to enjoy the fruits of their natural resource wealth". This implies that the concept often referred to as the "resource curse" is not an immutable principle, suggesting that economies reliant on natural resources possess the capacity to thrive and progress. Australia, Finland, Norway, New Zealand, Canada, the Netherlands, and the United States are only a few of the industrialised economies with plentiful resources. As a result, a recent development in "resource curse" literature has highlighted which factors contribute to the success of resource-based economies in breaking free of the curse. Mehlum et al. (2006), for instance, hypothesise that institutional quality is the primary driver of growth performance differences across resource-rich nations (Arezki and Van der Ploeg, 2011). Few researchers point to the importance of economic growth (Badeeb and Lean, 2017). The BRICS nations epitomise a typical resource-rich, technologically advanced country. South Africa's Research Infrastructure Roadmap, Russia's Innovation Strategy 2020, Brazil's Technological Innovation Act, and India's Decade of Innovations 2010–2020 Roadmap are all examples of innovation-driven development strategies that inform these nations' most recent development plans. China has had a substantial raise in its research and development (R&D) expenses, rising from "0.56% of GDP in 1996 to around 2.2% of GDP in 2018", as reported by the WDI (2020).

A number of studies claim that expenditures in human capital (Rahim et al., 2021), guidelines focused on improving the functioning of institutions (Eslamloueyan and Jafari, 2021), and financial growth (Wu et al., 2018; K. Wang et al., 2019) are efficient ways to address the resource curse issue. However, no prior research has concentrated on using an integrated strategy of sustainable development and finance to mitigate the resource curse problem. It is therefore imperative to create an integrated strategy that takes into consideration criteria for financial development, human capital, and institutional excellence - all of which are meant to enable the extraction of natural resources to be a blessing rather than a curse. (Destek et al., 2023; Shan et al., 2024). Therefore, the present research proposes an integral approach (fintech, green finance and green innovation) for mitigating the resource curse phenomenon in developing nations.

Fintech, green finance, and green innovation are all examples of cutting-edge technologies that the BRICS nations have invested in as a means to promote long-term economic development without relying on an abundance of natural resources (Lisha et al., 2023). Natural resource and innovation studies might benefit greatly from looking at the BRICS nations as a case study.

Fintech is an important subject in the field of technology. The Financial Stability Board (2016) suggests that "fintech" is "financial innovation produced through technology that creates new business models, processes, or products that have strong effects on financial services, institutions, and markets". The integration of many technological advances, including wireless networks and cell phones, has been expedited by the progress made in technological developments (Croutzet and Dabbous, 2021). "Blockchain technology, artificial intelligence, security, Internet of Things and cloud computing" are all part of this. Financial development may aid in achieving green innovation propelled by green financing (Yang and Ni, 2022; Ahmed et al., 2022); this is shown by recent research (Karim et al., 2022).

Fintech, as a new kind of technology, has an impact on business operations and output by altering the availability and cost of financing options. The resource curse theory could be disproved in BRICS countries as a result of this (Tian and Feng, 2023) as it is likely to affect the environment and the economy. The effect of fintech innovation in green finance has not been well researched or recorded, as highlighted by Tan et al. (2023). Thus, as a technological advancement, fintech can influence the production and operation of firms by altering financing factors through the accessibility of financial services; therefore it is certain to have an effect on both the environment and economy (Cao et al., 2021) Nevertheless, the influence of fintech innovation on the expansion of sustainable economic growth does not receive much attention in previous studies (Zhou et al., 2022).

Sustainable economic growth relies on this form of development (Ahmed et al., 2022). To provide sustainable financial services in BRICS nations, fintech is in a prime position thanks to the use of "big data analytics and machine learning" to encourage a shift towards environmental consciousness among families and SMEs (Lisha et al., 2023) in the next few years. Taking into account environmental issues, green technological innovation (GTN) is tied to environmental legislation (Hu et al., 2022). Green Finance (GF) paves the way for GTN, which might boost resource utilisation efficiency and environmentally friendly goods, providing a potential solution to the resource curse (Tian and Feng, 2023) if implemented successfully. Currently, BRICS nations are experiencing an increasingly high level of technical innovation (Wu et al., 2020b). Examining the mechanism behind the impact of fintech innovation on green finance and proposing relevant policy implications is imperative and significant. This is due to the global recognition of green finance as a crucial developmental objective for all nations, as well as the swift convergence of finance and technology (Udeagha and Muchapondwa, 2023). Moreover, research in BRICS countries reveals that technological innovation may be leveraged to reduce the "resource curse" (Wu et al., 2020a; Hu et al., 2021). The current body of scholarly work mostly centres on the establishment and development of indicators for green growth, as shown by the studies conducted by Guo et al. (2017), Zhang et al. (2020), and Y. Yang et al. (2021). There have been many studies looking at how technical innovation and fintech affect monetary growth and how technological innovation affects environmentally friendly economic expansion. However, this research often neglects to acknowledge the significance of green finance in addressing the "resource curse" and promoting sustainable financial growth in BRICS nations. Similarly, the role of government regulations in moderating these effects is often neglected.

Governments should provide benefits to banks to encourage green finance activity, as suggested by Hu et al. (2013); this can mobilise their enthusiasm for involvement. Y. Wang et al. (2019) show that increasing the quantity of green funding via a modest policy may optimise the industrial structure. The group of authors further contend that implementing this approach will not adversely affect economic output or employment rates, achieving a mutually beneficial outcome for both the financial system and the ecology. To effectively tackle the challenges associated with excessive energy consumption, pollution, unregulated development, and uncontrolled expansion in businesses, as well as to advance initiatives centred on safeguarding the environment, conserving energy, and reducing emissions, it is crucial to adopt a green finance policy that integrates an environmental eligibility criterion into the domain of monetary credit (Guo and Fang, 2022). Several scholarly publications examine the quantitative impact of finance policy execution on a range of aspects, including the natural environment, the economy, and financial institutions (Aizawa and Yang, 2010; Pan et al., 2023) whereas quantitative studies of the effects of finance policy on business investment and financing practice have been simulated (Liu

et al., 2017). To achieve sustainable economic development by disproving the resource curse theory in BRICS nations however, qualitative research is still insufficient (Tamasiga et al., 2022). The current study aims to address the following issues based on the aforementioned research gaps and Table 1.

RQI: How could Fintech, based on innovative technologies, facilitate green finance?
RQ2: How could green finance break the resource curse hypothesis of BRICS nations to help their transition towards resource-blessed nations?
RQ3: How could the policies of BRICS nations guide green finance towards various industries to achieve sustainable economic growth?

To address the research questions outlined, this study presents a conceptual framework that provides insights into the potential advancements of fintech within the domain of green finance. The study's outcomes indicate that the influence of fintech innovation on green finance is substantial, primarily via two key channels: "green loans" and "green investment". "Green investment, green credit, and green finance" institutional laws are all bolstered by fintech innovation. To facilitate a more extensive investigation on how the integration of green finance into green innovation might potentially mitigate the negative effects of the "resource curse", namely via the "investment and real exchange rate channels", a novel model is developed in the present research. The possibility exists for the widespread use of green technology across the economy to alleviate the negative effects of economic growth reliant on natural resources. This can be achieved by improving the productivity of sustainable investments and minimising the repercussions associated with Dutch disease, such as the appreciation of currency rates. Finally, a two-tiered, multi-step framework is developed using the "Dutch Disease Theory" (DDT) and the "Resource Curse Theory" (RCT) to illustrate the BRICS nations' approach to policymaking in terms of helping the managers of both firms based on natural resources, as well as those not based on natural resources, to achieve their economic and sustainability goals through the prudent use of green finance.

2. Systematic review methodology

The principal purpose of a systematic review is to effectively answer a particular research question by meticulously locating and assessing all relevant academic works, thus providing a concise summary of the existing knowledge on the subject area. A systematic review is a methodical approach that involves using established protocols to identify and examine current studies, conduct a critical assessment of pertinent research, then collect, analyse, and evaluate data that is encompassed in the review. The primary objective of a systematic review is to offer a thorough and complete synthesis of relevant papers about a precisely defined research topic (Aiassa, et al., 2015). A reproducible research process is one that is both clear and easy to follow (Green and Higgins, 2005; CRD, 2009). The first stage in carrying out a systematic review, as explained by Tranfield et al. (2003), is to develop a research topic. To acquire findings that are achievable within a certain set of resources, researchers formulate research questions which are sets of synthetic propositions (Denyer et al., 2008; Denyer and Tranfield, 2009). The study topic is synthesized into four main ideas. CIMO is a framework for analysing the effects of an intervention by breaking it down into four categories: "(C) context (the group/aspect of interest), (I) interventions (the intervention of interest), (M) mechanisms (what causes the intervention), and (O) outcomes" (Sony and Naik, 2020). Our study's guiding question is thus formulated. With regard to industries dependent on or un-reliant on natural resources, fintech-driven green financial interventions, using the channels of investment and the exchange rate, can BRICS nations disprove the resource curse argument? The result will ensure long-term economic prosperity for BRICS countries. All potential interchangeable terms for each of the CIMO ideas are utilised throughout the review. This review strictly adheres to articles that include CIMO-related concepts.

Fig. 1 displays the indicative keywords used as a string in various combinations and databases. All fields in each database are searched using the search string. The title, abstract, keywords, and (if accessible) entire text are all good places to start. Articles from journals, conferences, books, and magazines that are indexed by the chosen databases are taken into account. Documents written in English are evaluated. The end date, October 2023, is chosen but the beginning date is disregarded. After that, we look over the abstracts and titles. As a result, duplicates are easier to weed out. The remaining abstracts are evaluated in light of the previously outlined criteria for inclusion and exclusion. The articles are reviewed in full to decide whether they are suitable for inclusion or not. To fine-tune the search parameters, the referenced publications are examined. There are 90 articles in the first findings, but after analysing the titles and abstracts, only 64 remain. The final sample consists of 38 papers after a process of reason-based removal following the CIMO framework. The objections made in these pieces are examined, with common elements being found. Each author works individually to classify the data in their studies. The next step is a dialogue between the two writers on the fundamental ideas. The proportion of people who agree with the statement is stated as 85% using a simple percentage. When a discrepancy occurs, the authors meet and talk it out, eventually reaching agreement. The norm (Jarvis et al., 2003; Sony and Naik, 2020) is consistent with this.

2.1. Theoretical background

The study's theoretical approach is grounded on the "Resource curse theory (RCT) and the Dutch disease theory (DDT)". The results of the RCT indicate a general trend where nations with ample resources exhibit somewhat lower rates of economic development compared to those with limited resources. This phenomenon may be attributed to several factors, one significant factor being the prevalence of natural resource exports as a dominant force in the economy (Alssadek and Benhin, 2023). The aforementioned factors may lead to a dearth of diversity, behaviour driven by rent-seeking, instances of corruption, and the presence of feeble institutions (Belaid et al., 2021; Malik and Masood, 2022).

Following this perspective, mitigating the adverse outcomes associated with an abundance of natural resources may be achieved by the implementation of policies that promote monetary diversification, enhance "governance and transparency", and augment investment in human resources (Zheng et al., 2023a). However, proponents of the Dependency theory claim that the extraction of resources has the potential to increase the value of the exchange rate. Consequently, this appreciation might negatively impact other segments of the financial system, such as industry and agriculture, by reducing their competitiveness (Bahar and Santos, 2018). An illustrative instance of this phenomenon is when the presence of oil reserves is identified and then is harnessed for economic gain. As a consequence, some sectors may see a decrease in monetary activity (Torvik, 2001). The proposition posits that the implementation of measures such as currency controls, diversification of investments into non-resource sectors, and prudent fiscal governance may mitigate the adverse impacts that arise from the misuse of natural resources on the overall economy (Zheng et al., 2023b).

2.2. Developing a framework for fintech-driven green finance

In the realm of fintech, blockchain represents an innovative approach to data sharing, whereby databases are interconnected inside a decentralised, peer-to-peer network that allows free access (Upadhyay et al., 2021). Due to blockchain's accuracy and openness, less opportunities exist for fraudulent data manipulation by corporations looking to cover up their participation in environmental harm (Fernando et al., 2021). Green investment may be enhanced by reducing the cost of manufacturing and identifying inefficiencies in corporate processes via

Table 1
Comparison of present research with previous studies based on CIMO logic.

Studies	Research type	Context (C)	Intervention (I)	Mechanism (M)	Outcomes (O)	Research gaps	Findings
Ronaldo and Suryanto (2022)	Quantitative	Fund Village in Indonesia	Green finance and green innovation	"Green finance influences sustainable development goals by green innovation and green micro-enterprises"	"Economic and Environmental sustainability"	More study is needed to better understand how village grants in Indonesia might help accomplish the SDGs.	The attainment of SDGs may potentially be achieved via the implementation of ecological and financial sustainability strategies. This can be facilitated by the utilisation of green finance mechanisms to assist in the development and adoption of green technological innovation as well as the establishment of green micro-enterprises.
Tamasiga et al. (2022)	Qualitative	African countries SMEs	Financial technology	"Connecting green fintech finances; green tech solution across SMEs sectors"	"Green economic growth"	There is a scarcity of research that uses network-based bibliometric coupling of journal articles in the domains of fintech and sustainable green growth; intending to explore the intersection of these two sectors.	The results indicate a rising tide of scholarly interest in the notion of "green fintech", as well as its connections to green economic development, climate change, and greening norms and standards.
Almansour (2023)	Qualitative	Fintech start-ups in the United Kingdom	Fintech and Artificial Intelligence (AI)	"Fintech start-ups effect the natural and firms' resources via AI implementation"	"Effective resource optimization"	There is a dearth of research on the impact that disruptive technologies like AI have on the internal organisational resources and external natural resources, such as minerals and the linked industries of fintech start-ups.	The research suggests that fintech start-ups may benefit from using AI in areas such as operations, digital marketing, and optimising the use of resources.
Awais et al. (2023)	Quantitative	South Asia, G9, Organization for Economic Cooperation and Development (OECD); Middle East and North Africa (MENA) member states.	Industry 4.0 based fintech	"Fintech based better resource utilisation, improved access to funds with better renewable energy deployment"	"Sustainable economic development"	The sustainability implications of fintech have only recently become a subject of discussion in the field of business management; there is a noticeable lack of research examining the practical applicability of fintech. Not only that, but no prior research has constructed a comprehensive green growth index and examined the influence of several fintech factors on it over a large sample throughout time.	The results reveal that although carbon emissions have a detrimental influence on green economic activity, the spread of the internet and fintech have a beneficial effect. Green growth may be hindered by factors such as population increase and unemployment.
Firdousi et al. (2023)	Quantitative	26 Morgan Stanley Capital International (MSCI) countries	Fintech	"Promotes renewable energy resource consumption and discourages carbon emissions by an integrated fintech and financial depth index model"	"Sustainable and economic growth"	There is not enough research available to draw broad conclusions on the impact of fintech adoption on carbon emissions and renewable energy use in underdeveloped countries.	The research finds that a growing economy has a beneficial effect on both renewable energy resource consumption (REC) use and carbon emissions (CE), whereas fintech advancement encourages REC usage and discourages CE.
Lisha et al. (2023)	Quantitative	Resource and non-resource industries	Fintech and green innovation	"Reducing carbon emission by firms' procedure and sustainable investment"	"Environmental sustainability"	Some research analysing environmental pollution trends and their connection to FIN are identified in a practical setting.	The findings of a three-quantile (0.10th-0.30th, 0.40th-0.60, and 0.70th-0.90th) MMQR reveal that the use of fintech and natural resources harms environmental sustainability.

(*continued on next page*)

Table 1 (*continued*)

Studies	Research type	Context (C)	Intervention (I)	Mechanism (M)	Outcomes (O)	Research gaps	Findings
Siddik et al. (2023)	Quantitative	Bangladeshi manufacturing SMEs	Fintech and circular economy practices	"Fintech guides the CEP via easy access to finance which results from sustainable performance"	"Sustainability performance"	Insufficient attention is given in current research to examining the correlation between fintech adoption (FA) and the sustainability performance of organisations, particularly within the realm of SMEs.	The findings show that fintech adoption greatly influences CEP and SP within organisations and that CEP mediates the connection between FA and SP.
Tan et al. (2023)	Quantitative	Panel of 22 countries along the Belt and Road Initiative	Fintech	"Financial technology facilitates the management of natural resources"	"Natural resources management"	Fintech innovation and natural resource management in the global context of the Belt and Road Initiative (BRI) have not been the subject of any prior research.	The research shows that natural resource management benefits from fintech advancements. The index of natural resources management is also greatly affected by the use of renewable energy and foreign direct investment. The results show that an efficient government plays an important role in the management of natural resources.
Shan et al. (2024)	Quantitative	Banking industries of BRICS nations	Fintech innovation and human capital	Fintech innovation, natural resources and human capital will influence sustainable environment in BRICS countries	Sustainable environment goals	In BRICS nations, little attention is given to improving a sustainable environment without an emphasis on fintech innovation, natural resources (NTR), and human capital due to unstable climate conditions	The results of the research indicate that fintech innovation (FNT) is a crucial tool in tackling environmental harm as it can aid in the digitalization of the financial sector and lower CO2 emissions from the banking sector
Present study	Qualitative	Resource and non-resource industries	Fintech and green finance	"Fintech facilitates the green finance which may break the resource curse hypothesis in BRICS nations via investment and exchange rate channel"	"Sustainable economic goals"	The significance of green finance in mitigating the resource curse and enabling sustainable economic development in BRICS countries is underappreciated in literature, as is the moderating influence of government regulation.	The research shows that if BRICS nations increase their green investment, they may break free of the resource curse that has plagued them. Findings also show that the development of highly competitive green goods and practices may impede real exchange appreciation, which is consistent with the Dutch disease theory (DDT).

increased information exchange (Yeoh, 2017). The use of blockchain technology has the potential to facilitate the analysis of carbon emissions (Pan et al., 2019), thereby aiding an economy in attaining a state of low-carbon efficiency (Fernando et al., 2021; Upadhyay et al., 2021). Furthermore, the use of blockchain technology has the potential to assist the proliferation of renewable energy sources, therefore making a significant contribution towards the overall goal of reducing carbon emissions (Wang and Su, 2020). Computer scientists utilise artificial intelligence (AI) to create intelligent computers that can learn and solve problems in the same way as humans can (Liengpunsakul, 2021). Siri on Apple's iPhones, and even more complex systems like those found in self-driving automobiles, are both examples of this technology (Liengpunsakul, 2021). AI's rising popularity and pervasiveness in today's high-tech cultures may be traced back to the fact that robots and robotics are increasingly able to solve issues that previously required human intellect (Goralski and Tan, 2020). Ojokoh et al. (2020) note that this technology "helps conduct complex work at levels beyond human skills". Ojokoh et al. (2020) also point out that one reason AI is gaining in popularity is that it can be used for data analysis to help address specific issues, which in turn promotes long-term economic growth. Security and the Internet of Things are two more components of fintech. According to Upadhyay et al. (2021), within the framework of sustainable development, fintech provides both overall security and data management security. As an example, the security of blockchain technology is unbreakable (Fernando et al., 2021). One way the Internet of Things may be used to promote environmentally responsible business practices is by keeping tabs on an organization's energy use in real-time (Fernando et al., 2021). The Internet of Things is one piece of infrastructure that may have a significant long-term influence if implemented properly (Bibri, 2018). Cloud computing is also considered part of fintech. The latter allows for more lucrative and long-lasting corporate operations (Grossman, 2009; Kumar and Vidhyalakshmi, 2012). Cloud computing offers many ecological benefits, including the effective utilisation of resources, the implementation of efficient systems, and the achievement of carbon neutrality (Zissis and Lekkas, 2012). Cloud computing plays a significant role in fostering the advancement of ecologically sustainable supply chains by obviating the need for physical resources and reducing corporate travel (Marston et al., 2011).

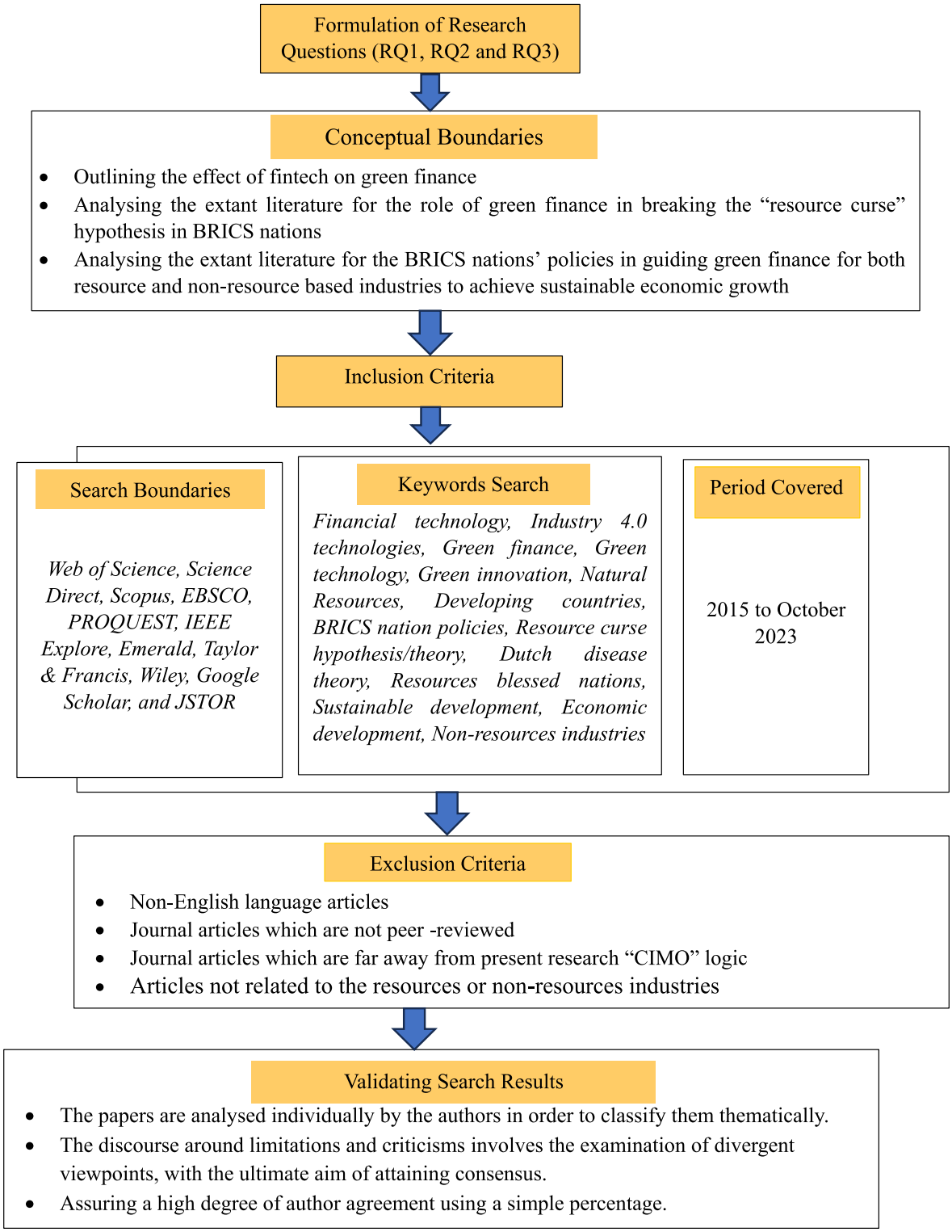

Fig. 1. Literature review protocol.

Fintech has also made significant progress in the field of risk management. Fig. 2 depicts the use of fintech tools such as big data, cloud computing, and artificial intelligence (AI) in supporting the provision of credit to SMEs. This is accomplished by using non-traditional financial statistics, such as cell phone usage and digital account activity, to build alternative credit ratings when extensive financial information or transaction records are not available. Hence, the emergence of fintech results in an increased volume of accessible data and a reduction in the associated risks of stakeholder and SME involvement. Finally, fintech can dramatically enhance the efficiency with which resources are allocated. Big data, cloud computing, and artificial intelligence are just a few of the technologies that have helped propel fintech forward in recent years. Algorithms built by computers can perform calculations far more quickly than people can (Ashta and Herrmann, 2021). As a result, expenses are reduced, risk management is improved, and more deals are available (Chen and Bellavitis, 2020). Direct trading of money supply

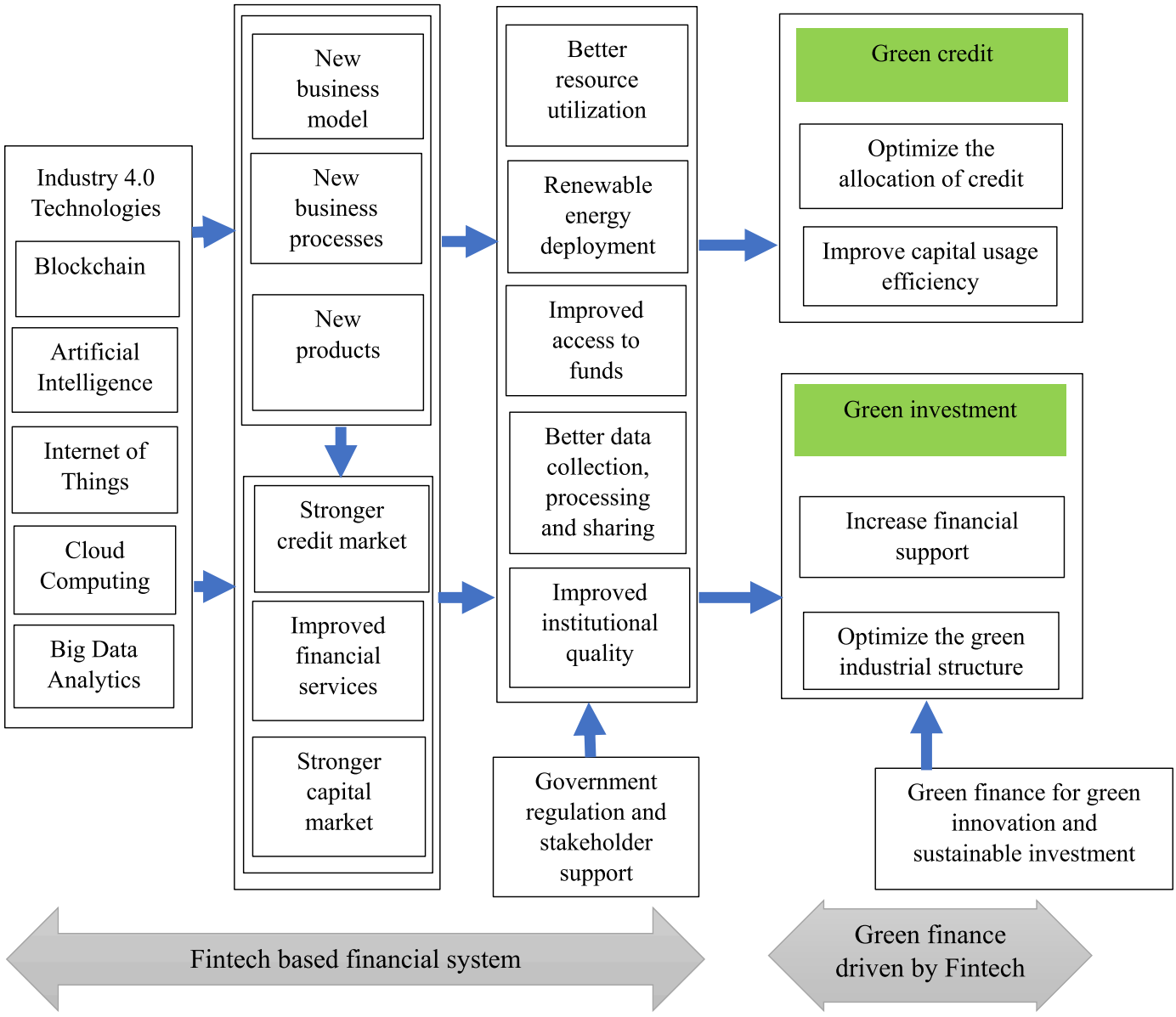

Fig. 2. Fintech based green finance facilitation.

and demand is made possible by internet-related technologies, such as P2P (peer-to-peer) or online lending (Akerman et al., 2022). Moreover, with dependency on internal resources rather than external financial channels, SMEs are more likely to be successful in their innovation endeavours. The development of fintech helps the green finance and green credit sectors in several ways, including better information transmission, risk management, and resource allocation (Zhou et al., 2022).

3. Theoretical analysis

This section consists of two sub-sections. The first section explains the mechanism by which green finance breaks the resources curse hypothesis in BRICS nations, while the second section explains the decision support framework for achieving sustainable economic growth by BRICS industries based on government.

3.1. Breaking the resources curse hypothesis by green finance and green innovation

Berkhout et al. (2006) argue that green finance is driving two significant transformations that have the potential to shift the role of natural resources in a financial system from being a burden to being a gift. The first aspect is the incorporation of additional value, while the second aspect pertains to the development of more innovative goods and services as shown in Fig. 3.

I. **Investment channel:** Gylfason's (2001) seminal work on the resource curse and human capital makes the observation that nations with plenty of natural resources tend to underinvest in their people. Perhaps the abundance of natural riches is 'blinding' these countries to the need of investing in their people to create stronger societies. The natural resource curse theory may also be explained by poor institutional quality (Alssadek and Benhin, 2023). There are two broad categories into which previous research on institutional quality and the "resources curse" might be placed. According to the first school of thought, the quality of institutions is negatively impacted by natural resources (Bhattacharyya and Hodler, 2014). The second body of research contends that the allocation of natural resource revenue is determined by the strength of the governing

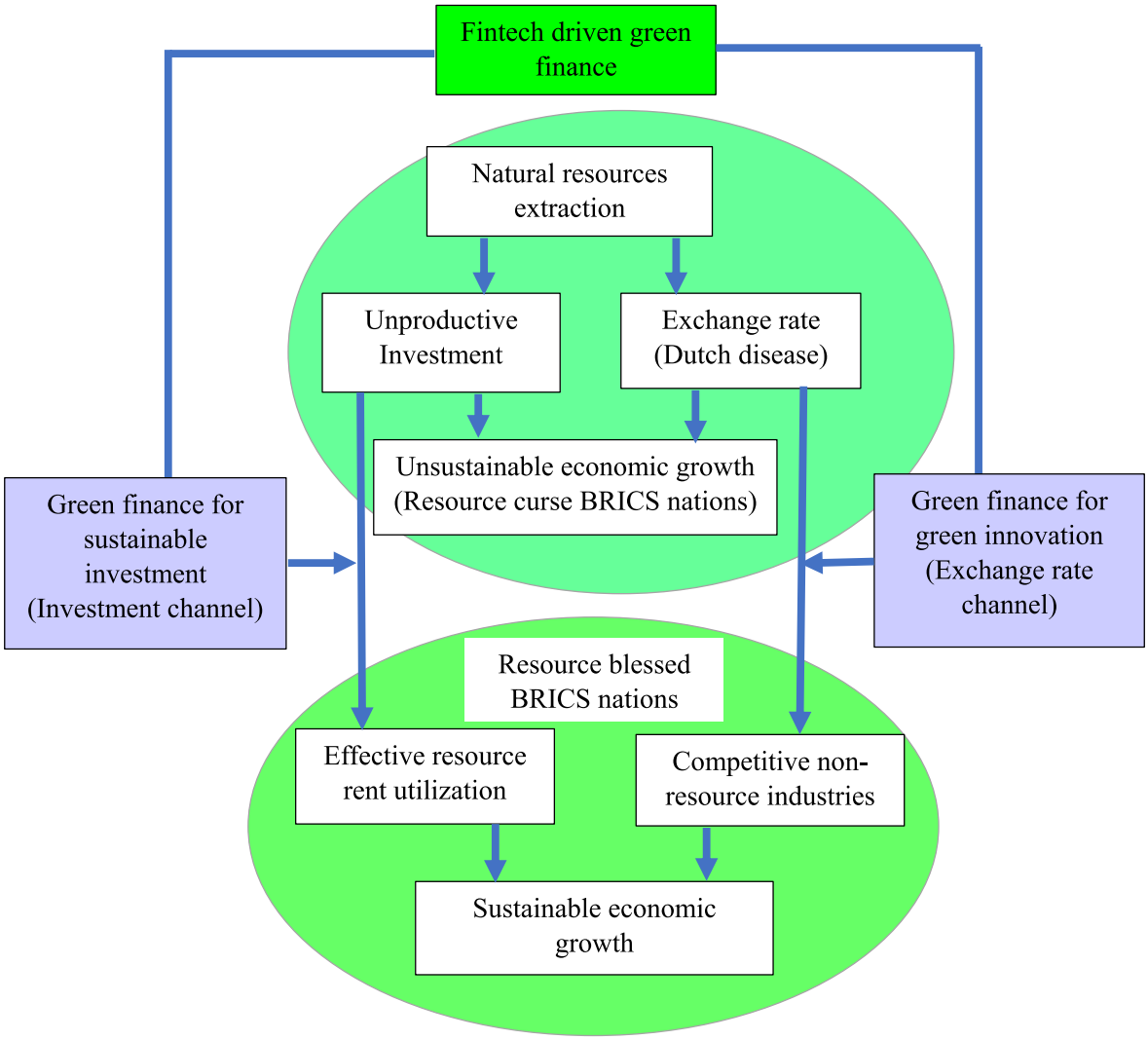

Fig. 3. Nexus between natural resource extraction, fintech and green finance for breaking BRICS nations' resource curse hypothesis.

institutions in place (Bologna and Ross, 2015). Poor institutional quality has been shown to result in wasteful spending.

- **Sustainable investment based on green finance:** Natural resource businesses benefit from green investment because this increases the value of their investments, allowing them to be more productive or long-lasting. The economy expands in a way that is consistent with sustainable aims as the efficiency of investment improves (Badeeb et al., 2023), meaning that businesses shift their spending to greener endeavours. Natural resource-based economies are often plagued by the white elephant concept (Gylfason, 2006; Nili and Rastad, 2007). As a result, increased green financing may facilitate the substitution of productive investment that promotes long-term economic development for non-productive investment. This method of making investments is known as "the investment channel". Green finance is an alternative to traditional financing that prioritises environmental safety, green business, and long-term economic growth (Falcone and Sica, 2019; Kang et al., 2019). The study conducted by Zhou and Cui (2019) provides evidence that the adoption of GF positively influences corporate social responsibility (CSR) and leads to improved environmental performance in the business sector. Environmental, social, and governance (ESG) objectives may be met with the aid of improved finance for environmental planning and financial instruments (such as financial institutions) tailored to climate-friendly initiatives (Tolliver et al., 2019). Green credit, provided it abides by environmental standards, may provide financial support for national SD, as shown by An et al. (2021). Strong growth in GF, as stated by Zhang and Wang (2021), may cut down on coal use and significantly boost energy SD. Both immediate and future carbon emissions are reduced greatly by GF, as researched by Mamun et al. (2022). The best resources allocation and the resolution of environmental externalities are both promoted according to Zhao et al. (2022). Reboredo (2018) demonstrates that the issuance and trading of green bonds result in positive environmental externalities, which is useful for advancing clean energy initiatives. Wilder Hill Clean Energy Index returns are significantly correlated with green bond prices, as shown by Shi et al. (2018). Agliardi and Agliardi (2019) contend that increased ecological consciousness between investors would drive demand for green bonds, which in turn will cut financing costs for borrowers. The proliferation of "green credit" is driven by the simultaneous pressures of environmental concerns and economic transformations (Badeeb et al., 2023). The observed phenomenon may be ascribed to the prevalent use of indirect financial methods and the favourable status of banks in BRICS countries.

II. **Exchange rate channel:** In brief, the Dutch disease is triggered by a rise in domestic income and demand for commodities due to a natural resource boom, as discussed by Gylfason (2001), Papyrakis and Gerlagh (2004), and Frankel (2010). This increase leads to a subsequent increase in prices and a corresponding increase in the real exchange rate. As a consequence, the expenses associated with exporting non-resource items increase in proportion to their value on

the international markets. As a result, the level of competition among these non-resource goods drops, along with the level of investment in them (Zheng et al., 2023a). The slowing of financial development in resource-abundant nations may be attributed to the phenomena sometimes referred to as the "spending effect." This phenomenon occurs when domestic inputs, such as labour and materials, are redirected into the natural resource sector. This causes a noticeable rising trend in the prices of various inputs within the local marketplace. The increase in production costs leads to a decrease in output in other businesses that have historically focused on exports, such as manufacturing and agriculture (Zheng et al., 2023b). The "pull effect" of resources on non-resource industries is a recognised phenomenon (Humphreys et al., 2007). According to Zheng et al. (2023a), the expansion of resource production may have a detrimental impact on non-resource output and total economic development due to the "spending" and "pull" effects. This assertion is especially true when non-resource industries, such as manufacturing, have a more pronounced beneficial impact on economic development via the occurrence of spillover effects, as opposed to resource sectors.

- **Competitive non-resource industries based on green innovation:** Green innovation, as defined by Tidd et al. (1997), allows for shifts in the status quo by spawning novel goods and services that boost the value of companies, sectors, and even countries while also possibly reshaping the production landscape and consumer preferences in sectors that rely on few or no natural resources. Resource-based economies are prone to experiencing the phenomenon known as the "Dutch disease," which refers to the strengthening of the real currency rate resulting from booms in natural resources (Tian and Feng, 2023). However, the negative effects of this phenomenon might potentially be alleviated by the implementation of innovative strategies. When natural resource prices rise, the actual exchange rate rises as a result. Non-resource items see a price increase in export markets as their relative value increases. Therefore, the non-resource sectors of the economy suffer a loss of competitiveness. However, Badeeb et al. (2023) state that competition from new items becomes more relevant than small adjustments in pricing for existing products. Thus, the green innovation results in high-value technical green goods that are resilient to the negative impacts of a rising real exchange rate. This is the reason for this mechanism, the "exchange rate channel". Green consumption is on the rise because consumers are refining their ideas about what constitutes responsible spending while expanding their knowledge of the topic (Dangelico and Vocalelli, 2017). According to Taghizadeh-Hesary and Yoshino (2019), the usability of a product is the deciding factor in whether or not customers will purchase it. Higher purchase intent is associated with increased utility gained from using eco-friendly items. If consumers exhibit a higher propensity to purchase environmentally friendly products and if enterprises use sustainable manufacturing practices to produce innovative green goods, it is plausible that the market might see an increase in competitive dynamics (Wang et al., 2022a). Furthermore, empirical research shows that the implementation of GI effectively mitigates the adverse environmental impact resulting from a company's operational activities. This implementation also yields enhanced profitability via the optimization of expenses and waste management strategies (Weng et al., 2015; Yan and Zhang, 2021). Consistent with the findings of both Wang et al. (2021) and Kraus et al. (2020), GI is shown to be a determining factor in the long-term success of manufacturing companies by fostering innovation and efficiency. The underlying principle of green technological innovation is based on the idea that advancements in goods, services, and processes have a significant role in diminishing energy consumption and the release of pollutants (J. Yang et al., 2021; Huang et al., 2022; Zhang et al., 2023). A growing body of academic literature suggests that embracing this strategy might successfully promote the achievement of a sustainable balance between economic progress and environmental conservation (Guo et al., 2018; Bai et al., 2020; Tian and Pang, 2023), as it can boost industry competitiveness and environmental performance. By enhancing production and processes, green technological innovation aids in the intensification of energy consumption and the consumption of renewable energy sources. As an added bonus, renewable energy may help the economy and the environment at the same time (Li et al., 2022; Wang et al., 2022a, b). Non-resource firms are able to remain competitive despite an appreciating currency rate because of green technology innovation; this also helps cut down on manufacturing costs for businesses. (Hao et al., 2021).

3.2. *Policy based decision support system for achieving sustainable economic growth by BRICS industries*

The pursuit of profit drives the actions of businesses. Because of this, it is crucial for policymakers in these economies to keep enterprises (and consumers) in check to prevent wasteful resource utilisation. Putting more authority in the hands of lower levels of government is a good strategy to consider. In a fiscally decentralised system, for example, individual municipalities may come up with their own plans for how businesses might best put the region's natural resources to use in order to encourage long-term development in the economy (Zheng et al., 2023) in any way they see fit. Hence, it is essential for regulatory authorities in developing nations to consider the integration of technology advancements within their environmental regulatory frameworks. This measure would facilitate the acquisition of essential mechanisms pertaining to incentives and penalties, including the withdrawal of corporate licences, monetary penalties, and the implementation of a carbon tax, in cases of non-compliance with environmental legislation. There is a higher danger of poor ecological efficiency in BRICS countries due to a variety of financial obstacles, hence bold GFN activities are needed. Policies favouring GFN systems in different sectors are open to creation and implementation in the governments of BRICS nations. Presently, the use of green bonds and other financial mechanisms is employed to ensure the enduring sustainability of environmental endeavours (Wang et al., 2022a, b). Green bonds are a "kind of fixed income security that is issued specifically to fund ecologically conscious endeavours". These bonds often come with a wide range of tax incentives, with the goal of increasing adoption and decreasing the GFN gap. BRICS countries now emphasise a high priority on green financing. For instance, to encourage businesses to take a more active role in ecological sustainability, the Chinese government's 13th Five-Year Strategy propose establishing a GFN system (Muganyi et al., 2021). Specifically addressing the use of green financing based on developing fintech, Fig. 4 depicts a two-stage, multi-step structure based on the strategies of BRICS countries to highlight how diverse resource and non-resource businesses may achieve long-term economic development. "Human welfare (HW), including worker welfare, consumer welfare, and human right privacy; the environment (E), including carbon emission, energy utilisation, landfills, and remanufacturing; and corporate benefits (CB), including profit maximisation, improved operations, and worker efficiency"; these all need to be considered in any framework for sustainable social welfare (SSW) (Choi et al., 2022). Initially, we recommend that the top-level policymakers of BRICS countries establish safeguards for people's well-being. Policymakers need to take steps to encourage industries to reach the best possible SSW once the SSW is defined. Secondly, at the ground level, each sector should make their own choices about the utilisation of resources (both natural and firm-based). Each resource industry, using the RCT as a basis, should identify the causes of unsustainable economic growth (UEG) (driven directly by natural resource exploitation) and document them. Each non-resource sector should also, using DDT, identify the elements (driven indirectly by NRE) that account for UEG. Finally, within the norms and regulations established by policymakers or governing organisations, each sector should take steps to

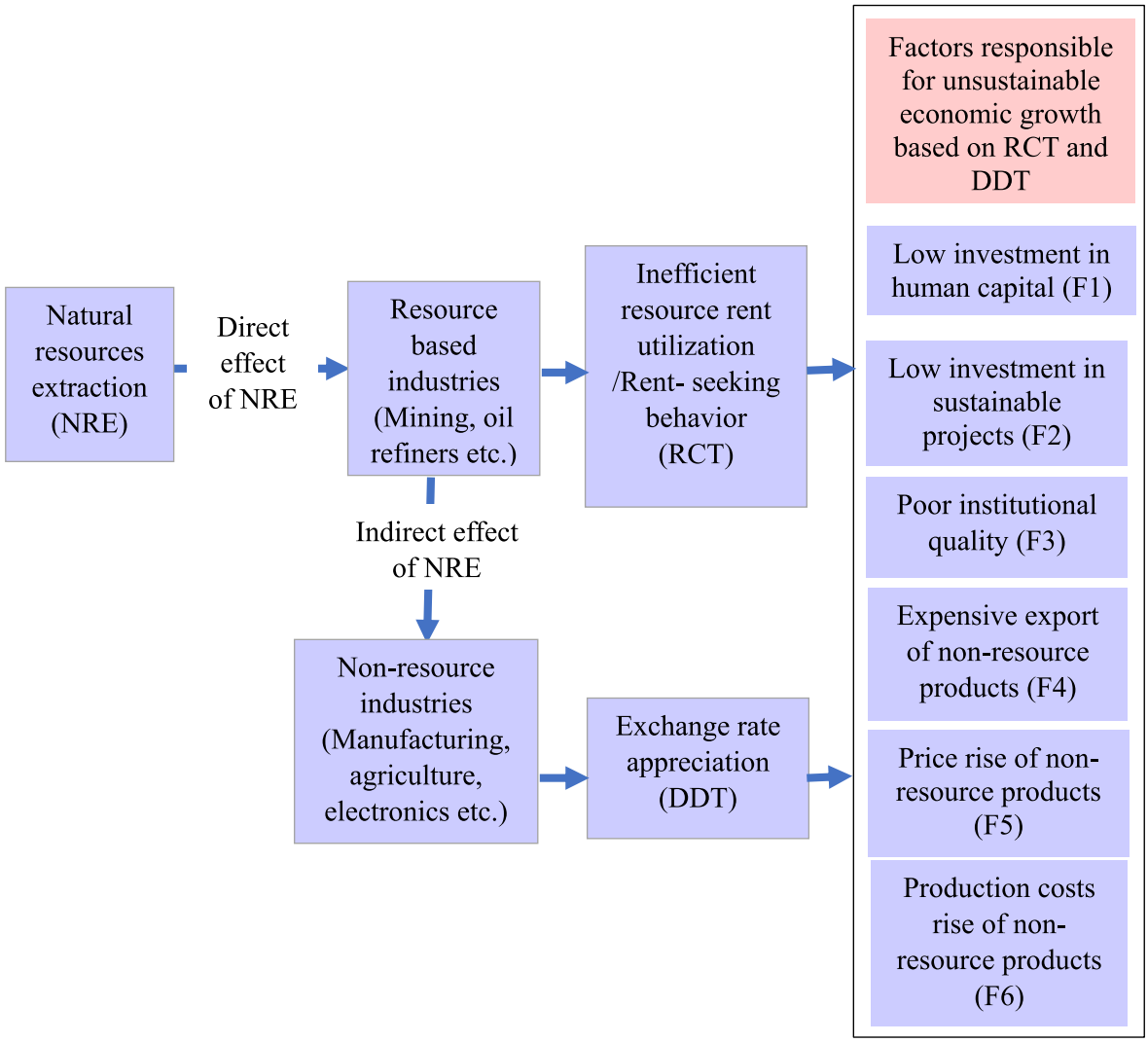

Fig. 4. Factors responsible for UEG based on RCT and DDT for BRICS industries.

maximize its own advantages. Also, as seen in Fig. 5, a feedback loop connecting industry results with policymakers is necessary to allow for any adjustment of incentive schemes and the re-ordering of goals.

4. Discussion of findings

In light of RQ1, it has come to our attention that online enterprises and/or monetary organisations are now offering novel monetary business models. These models are considered highly innovative due to their utilisation of emerging technologies, which possess the capacity to revolutionise the monetary services sector. "The Internet, mobile Internet, big data, artificial intelligence, interconnect technology, distributed systems, security technology", etc. are all examples of emerging technologies (Awais et al., 2023) that are worth exploring. Fintech encompasses many different types of financial transactions, services, and products, such as online payment processing, financial advice, project finance, savings and checking accounts, credit cards, insurance, and even regulatory compliance.

New companies, products, and business models are emerging as a result (Li et al., 2023) of these advancements. P2P lending, crowdsourcing, big data credit, robotic financial advisers (robo-advisors), blockchain, and virtual currencies are all examples. According to Lisha et al. (2023), contemporary business models exhibit characteristics such as being "asset-light, low-profit, scalable, compliance-light", and are depicted by fast development. Adopting fintech may help green finance since it opens the door to alternative funding mechanisms such as digital financing (Dorfleitner and Braun, 2019).

This confirms the conclusion made by Cen and He (2018), who argue that fintech fosters GF. To propel a sustainable economy, fintech leverages cutting-edge tools like big data and AI (Wang et al., 2022b). The following study proposal may be made for future research based on the preceding discussion.

> **P1:** Financial technology can encourage green finance by utilising various Industry 4.0 technologies which facilitate resource utilisation, resource allocation, information sharing and improved access to funds.

Regarding RQ2, the present findings indicate the U-shaped link between natural resource reliance and sustainable economic development in BRICS nations. If a BRICS country continues to rely on its natural resources, leading to deindustrialization up to a certain point, the resource curse will become a blessing as the country advances its infrastructure (green finance and green innovation) and institutional base (Badeeb et al., 2023). Research shows that countries whose GDP primarily relies on natural resources have a positive association with elevated levels of inefficient expenditure and appreciation of the currency rate (Nili and Rastad, 2007). A country that heavily relies on

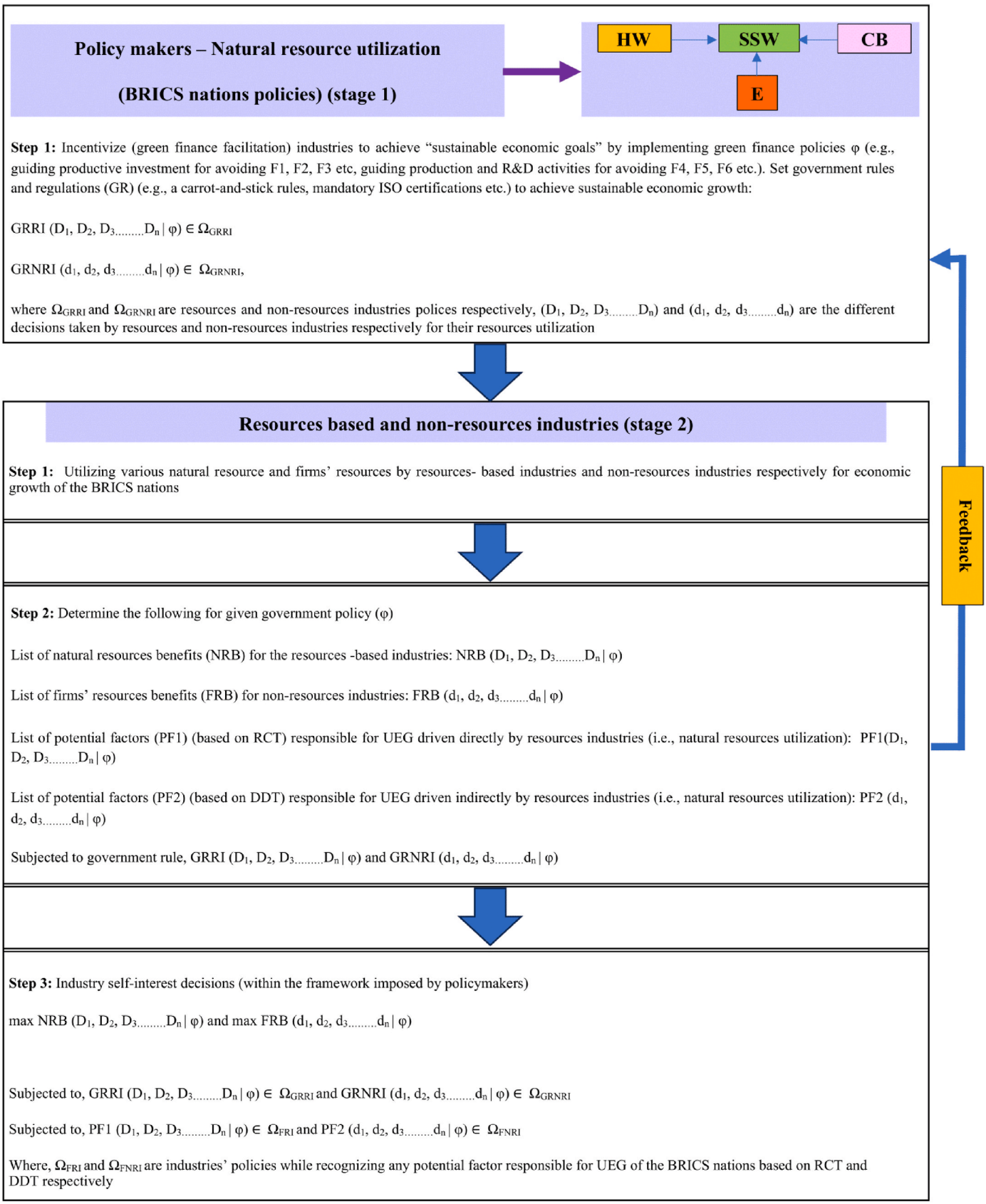

Fig. 5. Policy driven decision support framework for achieving sustainable economic growth.

resources may potentially overcome the negative consequences associated with this dependence, sometimes referred to as the "resource curse, " by effectively utilising the cash generated via green finance. By strategically directing these funds towards initiatives that prioritise efficiency and actively contribute to economic growth, the nation might successfully mitigate the adverse effects typically associated with resource dependence (Wang et al., 2022a). These results disagree with those of Mehrara (2009), who suggest a U-shaped relationship among oil revenue and financial growth. Even though oil money initially helps these nations promote economic activity, it quickly becomes a burden once they pass a certain point. In contrast, BRICS nations have had a higher rate of growth and have built up a stronger industrial and institutional foundation (Udeagha and Muchapondwa, 2023) than other nations. Therefore, BRICS nations may use their natural richness to break free of the resource curse (Tian and Feng, 2023). In addition, because the government can only allocate so much money towards green programmes, green financing paves the way for private firms to shoulder the financial burden. These programmes play a crucial role in promoting environmentally responsible development in the region as they contribute to the preservation of ecological integrity, facilitate the establishment of new environmentally conscious industries, and expedite the growth of credit intermediaries backed by the international financial community's strategic approach (Wang et al., 2022a). As one of the most efficient strategies to halt environmental deterioration, this result shows how the BRICS region may benefit from green financial instruments to build a better world. In turn, a cleaner environment will encourage the growth of alternative energy sources in the area. Udeagha and Muchapondwa (2023) observe that the aforementioned outcome serves as evidence of the efficacy of the Green Financing Task Force and the BRICS nations in promoting GFN advancement. Businesses may reduce their environmental impact and protect natural resources by implementing green initiatives that make use of eco-friendly technology and materials. This study provides evidence supporting the importance of GFN in mitigating ecological degradation in the BRICS region, despite its novelty and limited acceptance among traditional financial organisations. However, Rasoulinezhad and Taghizadeh-Hesary (2022) argue that the global economic slowdown is due to the lack of financing for green initiatives as a consequence of the COVID-19 outbreak. As a vital green finance instrument for supporting green initiatives, it makes sense for BRICS countries to increase the quantity of eco-friendly securities, given that empirical data reveals that GFN minimises environmental deterioration and thus enhances ecological integrity (Tian and Feng, 2023). As a consequence, the economies of the BRICS nations will grow once again, and environmental protection will strengthen. Consistent with these results, Chin et al. (2022) find that GFN is crucial in assisting Belt and Road Initiative (BRI) countries in achieving a green environment while supporting economic development. Meo and Abd Karim et al. (2022), who also investigated the link between GFN and environmental quality, find that while GFN promotes environmental sustainability in Switzerland, the United Kingdom, Hong Kong, Sweden, and the United States, the link is weaker or non-existent in Canada, Denmark, Japan, Norway, and New Zealand. In contrast to the results of Khan et al. (2022), who conclude that GFN considerably damages the environment in 26 countries, our results do not support this hypothesis. Similar but essentially identical results are found in other studies by Zakari and Khan (2021), using different datasets.

Green growth in China is shown to vary significantly between cities in terms of resource use, social and economic benefits, and environmental indices (Ma et al., 2022). Despite the fact that the scale of R&D investment leading to green innovation does not promote sustainable economic growth in the short term, research finds that it has a positive impact on the sustainable economic in the long term (Song et al., 2019), albeit a negative impact in the eastern and western regions at the present stage. This indicates that the exchange rate channel (healing of the Dutch sickness) is another means by which innovation might mitigate the ill effects of reliance on natural resources. This supports our claim that a green, inventive economy is more likely to create high-tech, environmentally friendly items that are less affected by an increase in the real exchange rate, so mitigating the Dutch disease. This result is consistent with the findings of Badeeb et al. (2023), who find that green innovation helps BRICS nations cope with the resource curse by lowering the effects of the Dutch disease, largely via the exchange rate channel. Green innovation improves resource utilisation in BRICS nations and gives businesses a long-term edge in the market (Tian and Feng, 2023) because of this. Companies that embrace green innovation may, as a result, develop cutting-edge goods, revamp manufacturing methods, inspire the emergence of new specialisations, and fuel the growth of knowledge-based sectors (Alvarez et al., 2015). Even if the actual exchange rate of a country rises, a country's exports will rise over time because its firms will become more competitive. Thus, innovation reduces the negative effects of an appreciating currency. In light of what has been said above, the following suggestions for further study are made.

P2: *Green finance may break the resource curse hypothesis in BRICS nations by providing more sustainable investments to resource-based industries (via investment channel), thus avoiding the resource-rent utilisation as supported by resource curse theory (RCT).*

P3: Green finance may break the resource curse hypothesis in BRICS nations by providing a green innovative approach to non-resource industries (via exchange rate channel); this increases the non-resource industries' competitiveness as supported by Dutch disease theory (DDT).

Regarding RQ3, recent studies suggest the establishment of a regulatory body (policymaker) driven decision making mechanism for both the resource and non-resource sectors. Policymakers in BRICS and other resource-based economies should increase their efforts to promote green innovation in light of recent findings by encouraging increased spending on research and development (R&D), investment in education, and programmes to make it easier for entrepreneurs to launch new ventures. Government policymakers should prioritise areas of research and development spending and think about ways to capitalise on innovations that boost long-term economic growth. The manufacturing industry, for instance, is a key driver of economic expansion and technical advancement. In addition, it stimulates the establishment of modernised and skilled jobs throughout the economy (Tybout, 2000). As a result of the worldwide rivalry and the natural resource curse, resource-based nations need to prioritise green innovation strategies in manufacturing and other non-resource businesses. To continue their upward trajectory, businesses should embrace green innovation to create new value, reduce expenses, maximize profits, and sustain expansion. Hence, to maximize non-resource benefits i.e. max FRB (d_1, d_2, d_3 … … … d_n $|\varphi$) for non-resource industries along with SSW, industrial policies need to consider government regulation for non-resource industries i.e. GRNRI (d_1, d_2, d_3 … … … d_n $|\varphi) \in \Omega_{GRNRI}$ while recognizing any potential factor (F4, F5 and F6) responsible for UEG of the BRICS nations based on DDT i.e., PF2 (d_1, d_2, d_3 … … … d_n $|\varphi) \in \Omega_{FNRI}$.

These findings are consistent with those of Udeagha and Muchapondwa (2023), who argue that the BRICS region should invest more in green innovation and development to improve the efficiency of energy use and reduce pollution from non-resource businesses. Maintaining competitiveness will also be aided by practical initiatives such as reducing energy use, investing in low-carbon cities, and developing power markets among the BRICS states. Finally, enterprises dependent on natural resources should use green finance to reinvest their windfall from natural resource assets in ways that foster long-term economic development (Wang et al., 2022a, 2023). BRICS nations can make a good choice by deciding to establish green funds. Many of society's problems, such as the natural resource curse phenomena, may be alleviated if academics, firms, and entrepreneurs are given the resources to do so. Hence, to maximize natural resource benefits i.e. max NRB (D_1,

D_2, D_3 … … … D_n |φ) for resource industries along with SSW, industrial policies need to consider government regulation for resources industries i.e. GRRI (D_1, D_2, D_3 … … … D_n |φ) ∈ Ω_{GRRI} while recognizing any potential factor (F1, F2 and F3) responsible for UEG of the BRICS nations based on RCT i.e. PF1 (D_1, D_2, D_3 … … … D_n |φ) ∈ Ω_{FRI}. The potential validation of the finding lies in the contribution of natural resources rent to environmental degradation in the BRICS region. Policymakers should prioritise the establishment of effective strategies that incorporate the positive influence of human capital in the extraction and utilisation of natural resources (Udeagha and Ngepah, 2021). This finding is aligned with Shan et al. (2024), implying a good association between human capital (HCP) and establishing sustainable environment (SEN). HCP may be efficiently applied in a number of ways to guarantee that BRICS nations can attain SEN. Higher skilled workers are innovative, and their inventiveness may result in green innovation, which is ultimately critical for SEN. A high HCP indicates a greater emphasis on green innovation, the establishment of green infrastructure etc. in a particular economy. Additionally, a better skilled workforce would practise energy-saving behaviours and be more environmentally sensitive, both of which can contribute to a long-term decrease in CO2 emissions (Kim and Go, 2020).

Based on the above discussion, the following research propositions might be posited as potential avenues for further study.

P4: Policies of non-resource industries must be aligned with the government policies of BRICS nations for guiding production and R&D activities while recognizing any factors (based on DDT) responsible for UEG; this must be further monitored by government rules and regulations.

P5: Policies of resource-based industries must be aligned with the government policies of BRICS nation for guiding productive investment while recognizing any factors (based on RCT) responsible for UEG; this must be further monitored by government rules and regulations.

4.1. Managerial and policy implications

The study's findings provide several key pieces of advice for banking sector managers and policymakers. Some of these measures involve encouraging environmentally conscious management and encouraging a green and creative company culture. Others include implementing these measures in order to prevent environmental damage. By offering tools such as green finance, fintech helps businesses that aim to reduce their environmental impact. As a result, C-suite executives should take advantage of these choices. Initially, it is important for marketing managers to emphasise the positive aspects of technology goods. As a result, fintech products and services will gain more mainstream appeal. By prioritising investment in pro-environmental projects like clean energy, pollution reduction, and a carbon-neutral industry, as well as instituting a reward system for employees who use such technologies, managers can use this research to promote green finance and green innovation.

The policy implications of the current study are many. To start with, green economic development may be achieved if economic and financial policymakers actively support the use of fintech. To ensure that the sustainable claims made for a product are accurate, blockchain technology may be utilised to supply customers with information that can be independently verified. Customers will be encouraged to buy more environmentally friendly goods thanks to this strategy. Secondly, the quality of the requisite infrastructure affects the extent to which fintech is beneficial. Therefore, it is the responsibility of government officials to guarantee that appropriate infrastructural preparations have been made to facilitate the widespread adoption of fintech. Thirdly, since users are able to evaluate performance in real time and make any necessary adjustments, fintech may be used to make enforcement of environmental regulations more efficient.

To aid in the execution of sustainable initiatives, the current body of research will direct financial institutions to actively invent and disseminate green goods and services. Green bonds provide funding for initiatives that benefit the environment, such as those that increase energy efficiency, lessen pollution, better manage air and water waste, and address climate change. The year 2019 saw a tripling in the issue of green sukuk, with the majority of the funds being used towards renewable energy projects. The goal of green sukuk is to meet the needs of safeguarding climate and environmental issues and is therefore a vital instrument for solving sustainability challenges. Another important factor in favour of sustainability promotion is the focus of international banks and other organisations on environmentally friendly initiatives. Due to factors such as lower project size, greater transaction costs, a lack of investment knowledge, and an absence of relevant financial mechanisms, financing certain green projects may be challenging. The promotion of green initiatives is frequently accomplished by government-backed green investment organisations via the provision of loans (commercial loans or preferential loans), risk reduction, and diverse financial sources. The current study suggests that banks that actively promote green financial products might gain not only direct advantages like fees for innovative products and intermediary revenue, but also indirect benefits like market share and social appeal. This is why banks and other financial organisations are so keen on fostering eco-friendly growth. Additionally, the current research offers avenues for banking sector strategies to optimise the mechanism for allocating loan funds, as well as for review and supervisory activities that integrate the enhancement and green transformation of various businesses. In order to encourage responsible distribution of green credit funds, and foster the growth of GI in businesses, the present research guides sectors such as cleaning to create a green measure assessments mechanism, a financial credit records of environmental breach details, and a macro-prudential inspection framework. Furthermore, this will guide the dual procedure of "incentive" and "a fine," for the banking sector. This can significantly boost financing to assist heavy-natural resource sectors upgrade if they do not proactively allocate funding in environmental conduct and green R&D. This will effectively encourage the green transformation of businesses. As a result, the current findings advise nations dependent on natural resources to employ innovation to leverage the wealth generated by these resources in order to achieve sustainable economic growth. Among the BRICS, creating grants for innovation can be an excellent pathway. These grants can provide a framework that helps researchers, companies, and entrepreneurs come up with inventive remedies to many of the problems facing society, such as the situation known as the "curse of the natural resource".

The "International Platform for Sustainable Finance" (IPSF) was created in 2019 by the "European Union, China, Canada", and other nations. Their goal is to improve the promotion of sustainable development by coordinating and strengthening international cooperation and sustainable financial categorization, disclosure, standards, and labelling. As innovation capital acts as a conduit in the "green finance and sustainable economic growth" mechanism, current research may also direct the government towards the upgrading of the manufacturing sector via green technical innovation and active market-driven innovation capital. This may be achieved by laying the groundwork for green innovation. The government should push forward with reforming the science and technology sector, giving research institutions more freedom, exploring more appropriate assessments based on the peculiarities of fundamental research and experimental development, and improving talent development, selection, and reward systems. Additionally, more significant tax advantages should be offered for green innovative firms. Investment in scientific and technical R&D should be enhanced to deal with exchange rate appreciation by upgrading the products and services of non-resource sectors.

5. Conclusion, limitations and future directions

Economic development in BRIC countries, which are wealthy in natural resources, has been negatively impacted by the price of minerals and oil. Therefore, current studies corroborate the RCT's findings that extracting natural resources might slow economic expansion owing to rent-seeking behaviour, insufficient diversity, and unstable institutions. Furthermore, natural resource dependence may cause the Dutch disease, whereby an increase in the export of natural resources raises the real exchange rate and reduces the profitability of the industrial sector. This means that a rise in the value of the exchange rate will diminish the overall quantity of capital in BRICS countries where the production sector is more capital intensive than the commodities sector. New evidence suggests that green financing may undermine the RCT via the investment and the exchange rate channel (green innovation). Therefore, the current study builds a conceptual model that demonstrates how fintech innovation encourages the growth of green finance by means of green credit, green investment, and other processes. Green finance raises the bar for the quality of institutions, investments in human capital, and green initiatives. A potential solution to combat Dutch disease may lie in green innovation, which is propelled by green financing and results in greater resource utilisation efficiency, enhanced research and development, and eco-friendly goods. In this study, we use the research on RCTs and DDTs to establish "sustainable social welfare" (SSW), which includes human wellbeing while acknowledging potential causes responsible for UEG. We propose a regulation driven approach for managers of resource and non-resource businesses in BRIC countries to address the causes of UEG. Natural resource extraction may have a detrimental effect on sustainable economic development, but this research highlights the significance of policies that promote economic diversification, improve governance and transparency, and invest in human capital to lessen this impact. This study provides support for the hypothesis that diversification policies may promote development in non-resource sectors, hence reducing the adverse impacts of natural resource extraction on long-term economic growth.

There are limits to this research, despite the fact that it has produced helpful data. These might be seen as windows of opportunity for further study. Our research does not allow us to predict how different green funding options would affect environmental sustainability. Because of advancements in scholarly research, collecting relevant data and conducting future studies on the effects of different green funding techniques on the green economy is now much simpler. The BRICS area is specifically chosen because of its unique traits in green finance, fintech, and sustainable economic development. Future studies might confirm the findings by looking into the interconnections between the highlighted variables, such as load capacity factors for more industrialised, developing, and rising countries. In addition, the current body of research has ignored the need to fortify mechanisms for the oversight of fintech innovations in order to mitigate the negative effects of fintech risks without slowing down the field's forward momentum. Green economic development requires a greater emphasis in future on actively promoting the application of successes in fintech innovation and on deepening the transmission mechanism of fintech innovation. Although the research delves into the cause and impact of green innovation on the resource curse, other possibilities are still open. Firstly, additional data on pollutant emissions should be considered to make the indicator for green inventions more accurate. In addition, future research may consider follow-up studies to examine the relationship between the factors that impact the efficiency of green innovation to break the resource crusade and the Dutch sickness. In addition, Table 2 provides an explanation of future research issues that may be explored.

Table 2
Future research questions based on present research propositions for future research directions.

Present research question (RQs)	Present research proposition for answering RQs	Future research questions for exploration of future research directions
RQ1: How will fintech, based on innovative technologies, facilitate green finance?	*P1: Financial technology can encourage green finance by utilising various Industry 4.0 technologies which facilitate resource utilisation, resource allocation, information sharing and improved access to funds.*	• How can we foster the adoption of solar panels through the use of smart contracts and a P2P (peer-to-peer) paradigm that utilises blockchain technology? • How can an internet-based infrastructure for the management and financing of an environmentally friendly supply chain be developed? • How can the inverted U-shaped relationship between industrial pollution and the establishment of fintech-based green finance be broken? • How do innovations in financial technology and science help advance green finance by expanding access to green loans and driving up green investment? • How can the framework of industry be optimised by adopting fintech, therefore increasing the efficiency with which resources are allocated, decreasing the negative effects of financial friction, and enhancing the quality of the environment?
RQ2: How can green finance break the resource curse hypothesis of BRICS nations for their transition towards resource blessed nations?	*P2: Green finance may break the resource curse hypothesis in BRICS nations by providing more sustainable investments by resource-based industries (via investment channel), avoiding the resource-rent utilisation as supported by resource curse theory (RCT).*	• How can green financing be supported by major investments in both human resources and technology innovation, given that it cannot secure the achievement of ecological preservation programmes on its own? • How can we effectively promote the utilisation of green financial instruments to direct funds towards addressing the climate crisis and supporting sustainable projects within resource industries? • How can we effectively promote the trading of green bonds, which have generated positive ecological results and are instrumental for carrying out renewable energy strategies?
	P3: Green finance may break the resource curse hypothesis in BRICS nations by providing green innovative approach to non-resource industries (via exchange rate channel), increasing the competitiveness of non-resource industries as supported by Dutch disease theory (DDT).	• How can we effectively establish an intellectual property protection system that enhances enterprise engagement in green innovation? • How can energy efficiency be achieved through the structural growth of non-resource businesses by leveraging green innovation?

(*continued on next page*)

CRediT authorship contribution statement

Sanjeev Yadav: Conceptualization, Data curation, Methodology, Project administration, Writing – original draft. **Ashutosh Samadhiya:**

Table 2 (*continued*)

Present research question (RQs)	Present research proposition for answering RQs	Future research questions for exploration of future research directions
		• To what extent may the Dutch disease phenomenon provide a viable route for BRICS nations to alleviate their resource curse via green technological innovation (GTN), which improves resource utilisation efficiency and produces sustainable products?
RQ3: How will the policies of BRICS nations guide green finance towards various industries to achieve sustainable economic growth?	*P4: Policies of non-resource industries must be aligned with government policies of BRICS nation to guide production and R&D activities while recognizing any factors (based on DDT) responsible for UEG; this must be further monitored by government rules and regulations.*	• How can we effectively establish and enforce stringent environmental regulations that encourage outdated industries to transition towards more sustainable practices, thereby fostering the advancement of industrial structures and creating a conducive market environment for the growth of the green economy? • How will the environmental laws of BRICS nations contribute to the promotion of green innovation, thereby mitigating the Dutch disease phenomenon through the development of non-resource sectors? • How can the policies of BRICS nations facilitate the dismantling of regional barriers and encourage the unrestricted exchange of green technological innovation via open sharing of knowledge and technology?
	P5: Policies of resource-based industries must be aligned with government policies of BRICS nation to guide productive investment while recognizing any factors (based on RCT) responsible for UEG; this must be further monitored by government rules and regulations.	• How can resource-rich BRICS nations foster green economic development via investment in government performance and the deployment of government authority to guide green investment? • How can the policies of BRICS countries discourage foreign companies from entering the natural resource extraction industry and therefore preventing the underdevelopment of local economies and the resulting lack of sustainable growth?

Conceptualization, Data curation, Methodology, Validation, Writing – original draft. **Anil Kumar:** Conceptualization, Data curation, Methodology, Resources, Writing – original draft. **Sunil Luthra:** Formal analysis, Investigation, Resources, Validation, Writing – review & editing. **Krishan Kumar Pandey:** Conceptualization, Supervision, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

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