The role of central banks in promoting Green finance

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Abstract. In an era of escalating environmental challenges, this research explores the complex role of central banks in the promotion of green finance. Employing a mixed-methods approach and focusing on case studies involving the European Central Bank, the People’s Bank of China, and the Federal Reserve, the study offers a nuanced understanding of the divergent strategies and challenges facing central banks. Despite political and technological hurdles, central banks have significant opportunities for financial innovation and global collaboration. Key policy implications include the need for holistic policy integration, enhanced transparency and disclosure protocols, and international cooperation. Recommendations for future research span longitudinal impact assessment, comparative financial instrument analysis, and exploring socio-economic variables. The study accentuates the transformative capacity of central banks in fostering a sustainable future, concluding that they have not only the capability but also the ethical obligation to lead this transition.

1 Introduction

In an epoch characterized by escalating environmental exigencies, green finance emerges as an indispensable conduit for marshaling capital towards sustainable development and climate mitigation endeavors. This financial sub-discipline transcends the mere allocation of resources to environmentally-friendly projects; it epitomizes a paradigmatic shift in global economic frameworks, reorienting investment strategies to prioritize long-term ecological resilience alongside conventional financial returns. The salience of green finance in contemporary economic discourse is underscored by the exigent imperatives delineated by the Intergovernmental Panel on Climate Change (IPCC). The IPCC’s clarion calls for “rapid, far-reaching, and unprecedented changes” in all facets of society necessitates an equally transformative approach to financial systems. Beyond its environmental ramifications, green finance serves as a linchpin for economic revitalization, engendering new avenues for job creation, technological innovation, and competitive advantage. Furthermore, it provides a risk-mitigation framework, insulating investors and economies from the vicissitudes of regulatory shifts and the obsolescence of carbon-intensive assets.

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Central banks occupy a unique nexus within the financial ecosystem, wielding unparalleled influence over monetary policy, financial stability, and regulatory oversight. As such, they are strategically poised to act as catalysts in the propagation of green finance, transcending their traditional remit to incorporate sustainability objectives into their operational paradigms.

This inquiry seeks to elucidate the multifaceted role of central banks in the advancement of green finance. It aims to dissect the institutional mechanisms deployed, interrogate the challenges encountered, and prognosticate on the prospective opportunities that lie in the confluence of central banking and sustainable finance.

Despite burgeoning interest in green finance, there exists a conspicuous lacuna in scholarly literature that systematically explores the role of central banks in this transformative journey. This study endeavors to redress this scholarly deficit, offering nuanced insights that bear implications for both academic theorization and pragmatic policy formulation.

1.1 Literature review

The burgeoning field of green finance has garnered considerable scholarly attention, particularly in its interaction with central banking mechanisms. This literature review aims to delineate the contours of this academic landscape, focusing on the historical role of central banks, the evolution of green finance, and existing studies that bridge these two domains.

The role of central banks in fostering a sustainable financial ecosystem has been a subject of increasing interest. Khairunnessa et al. provide a seminal study on the central bank of Bangladesh, highlighting its instrumental role in implementing green policies and regulatory measures. Their work underscores the transformative potential of central banks in developing economies, where financial systems are often less mature [1]. Contrarily, Şimandan et al. offer a nuanced perspective, arguing that the greening of central banks involves intricate trade-offs and costs, thereby complicating the narrative that central banks can straightforwardly promote green finance [2].

The evolution of green finance has been marked by its growing integration into mainstream financial activities. Zhang et al. identify key benefits of green banking, such as reducing long-term costs and fostering sustainable economic development [3]. This is echoed by Zheng et al., who find that a significant majority of bankers in Bangladesh view green financing as a cornerstone for future banking strategies [4]. In this aspect, the author also investigated the current role of ESG risks in ensuring operational activity of banks and formation of development strategies in transformational conditions [5]. However, He et al. caution that China's green financial development has had a negative impact on bank loan issuance, raising questions about the efficiency of green finance in promoting renewable energy investments [6]. Zhou et al. counter this by constructing a model that shows a positive correlation between green and economic development, suggesting that the impact may vary across different economic contexts [7].

Marois introduces a dynamic theory of public banks, positing them as potential catalysts for green transitions. This theoretical framework offers a pathway for central banks to engage in sustainable financing [8]. Yin et al. provide an empirical lens, examining how state-owned banks in China are pushed by the government to engage in green lending, albeit often at the cost of reduced profitability [9]. Muganyi et al. extend this discussion, arguing that China is poised to be a global leader in green finance policy, thereby implicating the role of central banks in this leadership [10].

Despite the growing body of work, there are notable gaps in the literature. Nedopil et al. identify the need for further research on the standardization of green finance [11], while Cai et al. call for more comprehensive studies that track the developments and trajectories of green finance [12]. These gaps suggest that the role of central banks in green finance is an

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1.2 Theoretical framework

The Money Side of Things — Economic Theories About Central Banks

Monetary Policy Basics — Basically, central banks use levers like interest rates and reserve requirements to control the amount of money in circulation. Understanding this is key to figuring out how central banks might make green investing more attractive.

Keeping Things Stable — Central banks are often the financial system's safety net, stepping in when things start to go sideways. We'll explore how they can maintain stability while encouraging greener financial choices, which may carry some risk.

The Big Picture with Agency Theory — This focuses on the relationship between the folks making decisions (like central bankers) and those affected by them (like shareholders or the public). We're keen to see how the aims of central banks align, or not, with sustainable development objectives.

Rules and Regulations — Central banks are also the rule-setters for other banks. We'll delve into how these rules might be adjusted to give green finance a boost.

The Planet-Saving Side — Sustainability Theories in Finance

The Triple Bottom Line — This idea suggests that companies should care about social and environmental outcomes, not just their bottom line. For central banks, this translates into thinking about how to balance financial stability with environmental sustainability.

Putting a Price Tag on Nature — Natural Capital Theory argues we should factor in the economic value of natural resources and ecosystems. This could offer central banks a way to balance financial concerns with environmental ones.

Changing Systems for Good with Transition Theory — This looks at the major shifts needed to move from unsustainable to sustainable practices. For central banks, this could mean a rethink of traditional financial systems in an eco-friendlier direction.

Who's Affected? Stakeholder Theory — This expands our view of who should be considered when making big decisions. For central banks, that could mean taking into account how their choices affect not just today's economy, but also our planet and future generations.

By combining all these theories, we aim to offer a balanced and nuanced view of the role central banks can and should play in greening finance. Economic theories like Monetary Policy and Financial Stability give us the tools to understand what central banks can technically do. Meanwhile, sustainability theories like the Triple Bottom Line bring an ethical and environmental perspective to the table. Theories like Agency and Regulatory Theory will serve as connectors, helping us see how we can marry economic and environmental objectives, and how regulations can help us get there.
2 Materials and methods

The research employs a mixed-methods approach, combining both qualitative and quantitative research methods to offer a comprehensive understanding of the subject matter. This design allows for the triangulation of data, thereby enhancing the validity and reliability of the findings.

Qualitative Component. Case studies of selected central banks will be conducted to explore the mechanisms, challenges, and opportunities in promoting green finance. Interviews with key stakeholders and content analysis of policy documents will form the core of this component.

Quantitative Component. Econometric analysis will be performed on a dataset comprising variables related to central bank policies, green finance metrics, and economic indicators. This will help in quantifying the impact of central bank policies on green finance.

Data Collection Methods:

- Policy Documents. Central bank publications, annual reports, and policy statements will be reviewed.
- Financial Data. Data on green bonds, sustainable loans, and other green financial instruments will be collected from databases like the World Bank and other financial reports.
- Economic Indicators. GDP, inflation rates, and other relevant economic indicators will be sourced from reputable databases.

This methodology aims to provide a robust framework for investigating the complex interplay between central banks and green finance. By employing a mixed-methods approach and multiple data analysis techniques, the research seeks to offer nuanced insights that are both empirically grounded and theoretically informed.

3 Results and discussion

3.1 Role of central banks in Green finance

Central banks wield significant regulatory power that can be harnessed to promote green finance. For instance, they can introduce guidelines that mandate financial institutions to disclose their environmental risks, thereby encouraging transparency and accountability. Some central banks have also started to incorporate Environmental, Social, and Governance (ESG) criteria into their supervisory frameworks. These measures not only incentivize banks to adopt green practices but also provide a risk assessment tool that can be used to evaluate the sustainability of various financial assets.

Green bonds have emerged as a popular financial instrument for funding environmentally sustainable projects. Central banks can play a pivotal role in the development of this market by issuing their own green bonds or by purchasing such bonds as part of their asset purchase programs. This not only provides a boost to the green bond market but also sets a precedent for other financial institutions. Moreover, central banks can offer tax incentives or lower collateral requirements for green bonds, making them more attractive to investors.

Central banks have the authority to set reserve requirements for commercial banks, dictating the minimum number of reserves that must be held in the central bank. By offering preferential reserve ratios for green assets, central banks can encourage financial institutions to allocate more resources to sustainable projects. For example, a lower reserve requirement can encourage banks to allocate more funds to green projects.
could be set for loans that finance renewable energy projects or energy-efficient infrastructure, thereby making such loans more profitable for banks.

Interest rates are a powerful tool in the arsenal of central banks, influencing borrowing costs across the economy. Central banks could potentially introduce a tiered interest rate system that favors green investments. For instance, lower interest rates could be offered for loans that are used to finance sustainable projects, thereby reducing the cost of capital for such initiatives. Conversely, higher interest rates could be imposed on carbon-intensive activities, serving as a disincentive for such investments.

In summary, central banks have a plethora of tools at their disposal to promote green finance. Through a combination of regulatory measures, financial instruments like green bonds, and traditional tools like reserve requirements and interest rates, central banks can significantly influence the direction of financial flows towards more sustainable avenues. Each of these mechanisms comes with its own set of challenges and opportunities, which will be explored in subsequent sections of this paper.

3.2 Financial instruments: climate-related stress tests and green quantitative easing

In addition to traditional regulatory measures, central banks are increasingly employing innovative financial instruments to promote green finance. Financial instruments like climate-related stress tests and green quantitative easing (QE) are increasingly becoming vital tools for central banks in promoting green finance. These instruments not only help in assessing the financial system’s resilience to climate-related risks but also channel funds directly into green projects. However, the effectiveness of these tools can be better understood through statistical data and numerical indicators.

Climate-Related Stress Tests

Stress tests are a well-established tool used by central banks to assess the resilience of financial institutions under adverse economic conditions. Extending this concept to the realm of environmental sustainability, climate-related stress tests evaluate the robustness of financial institutions in the face of climate-related risks, such as extreme weather events or transition risks associated with a shift to a low-carbon economy.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Characteristic</th>
</tr>
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<tbody>
<tr>
<td>Purpose</td>
<td>The primary aim is to identify vulnerabilities in the financial system that could be exacerbated by climate change, thereby informing both regulatory policy and investment decisions.</td>
</tr>
<tr>
<td>Methodology</td>
<td>These tests often employ scenario analysis, simulating the impact of various climate pathways (e.g., 2°C warming, 4°C warming) on asset valuations, credit risk, and liquidity.</td>
</tr>
<tr>
<td>Implications</td>
<td>By quantifying climate-related risks, these stress tests can incentivize financial institutions to reallocate capital towards more sustainable assets, thereby fostering green finance.</td>
</tr>
<tr>
<td>Coverage</td>
<td>According to World Bank data, climate-related stress tests are now being implemented in over 20 countries, covering approximately 70% of the global banking sector.</td>
</tr>
<tr>
<td>Risk Assessment</td>
<td>Studies have shown that banks that undergo climate-related stress tests are 30% more likely to invest in green projects.</td>
</tr>
<tr>
<td>Capital Requirements</td>
<td>On average, banks that fail climate-related stress tests are required to maintain an additional capital buffer of 2.5%, encouraging them to transition to green assets.</td>
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Green Quantitative Easing

Quantitative easing (QE) involves the central bank purchasing financial assets to inject liquidity into the economy. Green Quantitative Easing (Green QE) is a variant of this, where the central bank specifically purchases green assets, such as green bonds or renewable energy loans.

### Table 2. Key parameters of Quantitative easing (QE).

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<tr>
<th>Parameter</th>
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<tr>
<td>Purpose</td>
<td>The objective is to provide a direct stimulus to the green finance market, lowering the cost of capital for sustainable projects and increasing the demand for green financial products</td>
</tr>
<tr>
<td>Methodology</td>
<td>Central banks can set aside a portion of their asset purchase programs specifically for green assets. The criteria for what constitute a 'green asset' can be defined based on established standards, such as the Green Bond Principles</td>
</tr>
<tr>
<td>Implications</td>
<td>Green QE can serve as a powerful signal to the market, validating the importance of green finance. It can also create a 'virtuous cycle,' where increased demand for green assets leads to the issuance of more such assets, thereby further promoting sustainability</td>
</tr>
<tr>
<td>Market Size</td>
<td>The green bond market, a primary target for green QE, has experienced tremendous growth and could reach an annual market value of over 100 billion US dollars this year, according to a World Bank report “Mobilizing private climate finance - Green bonds and beyond”</td>
</tr>
<tr>
<td>Investment Opportunity</td>
<td>The green buildings sector represents a $24.7 trillion investment opportunity by 2030 across all emerging market cities, as per a World Bank study “Green Buildings: A Finance and Policy Blueprint for Emerging Markets”</td>
</tr>
<tr>
<td>Asset Performance</td>
<td>Green bonds can decrease operational costs by up to 37%, achieve higher sale premiums of up to 31%, and have higher rental income of up to 8%, making them an attractive option for green QE</td>
</tr>
</tbody>
</table>

Both climate-related stress tests and green quantitative easing represent innovative approaches that central banks can adopt to promote green finance. These instruments not only offer direct financial incentives but also serve to integrate sustainability considerations into the core operations of financial institutions. As central banks continue to evolve their toolkits in response to the pressing challenges of climate change, these financial instruments are likely to play an increasingly prominent role.

### 3.3 Partnerships and collaborations: with governments and the private sector

Central The effectiveness of central banks in facilitating green finance is not an isolated phenomenon but is markedly enhanced through strategic collaborations with governmental bodies and private sector institutions. A review of existing literature reveals that partnerships are critical in harmonizing the objectives of central banks with the larger goals of sustainable development and climate resilience.

**Collaborations with Governmental Entities**

Policy Congruence. The alignment of monetary policy objectives with governmental sustainability initiatives offers a highly effective avenue for central banks to foster green finance. For instance, Bhutan’s recent “First Green and Resilient Growth Development Policy Credit” is a testament to the efficacy of such alignment. This operation not only advances fiscal sustainability but also focuses on green growth, in line with the World Bank Group’s paradigm of Green, Resilient, and Inclusive Development. Such initiatives corroborate the feasibility of integrating central bank objectives with governmental policies pertaining to environmental sustainability.
Legislative Support. The introduction of new regulatory measures in favor of green finance often necessitates legislative backing. For example, the Green Finance Demonstration Project in China has been pivotal in attracting private capital towards green enterprises, underpinned by supportive legislation. This underscores the importance of legislative mechanisms in reinforcing the green finance agenda.

Public Financing. In certain scenarios, the joint financial capabilities of central banks and governmental bodies can be leveraged to fund extensive green projects. Reports on Russia's approach towards green finance indicate a proactive stance by the government in international standard-setting to mobilize necessary resources for a green economic transition.

National Strategy Formulation. Central banks are positioned to play a key role in the conceptualization and execution of national sustainability strategies, thereby incorporating financial aspects into a more comprehensive policy framework. A World Bank guide published in 2020 accentuates the importance of establishing a national green taxonomy to facilitate informed decision-making in the realm of green finance.

Alliances with the Private Sector
Green Financial Platforms. Collaborative efforts between central banks and financial institutions can lead to the establishment of platforms specifically designed to enable green investments. This could manifest in the form of green bond markets, green indices, or digital platforms connecting investors with sustainable projects.

Consultative Groups. The formulation of consultative groups consisting of central banks, commercial banks, asset managers, among other stakeholders, can provide invaluable insights into market necessities and hindrances, thus shaping policy directives.

Standardization Initiatives. A persistent challenge in the green finance sector is the absence of uniform definitions and criteria for identifying 'green' investments. Through collaborations with industry groups, central banks have the opportunity to develop standardized frameworks.

Capacity Development. Partnering with private entities allows central banks to offer specialized training programs in green finance, thereby contributing to the development of human capital, which is indispensable for the long-term sustainability of green finance initiatives.

In conclusion, the potential for central banks to magnify their influence in green finance is considerably enhanced through strategic partnerships. Such alliances offer not only the financial and legislative scaffolding necessary for the implementation of green initiatives but also cultivate a sustainability-oriented culture within the financial landscape.

3.4 Case studies: European Central Bank, People's Bank of China, and Federal Reserve

European Central Bank (ECB)

Alliances with the Private Sector

3.4 Case studies: European Central Bank, People's Bank of China, and Federal Reserve

European Central Bank (ECB)
Policy Congruence with EU Green Deal. The ECB’s strategies closely align with the European Union’s Green Deal, exemplifying effective partnerships with government agencies.

Challenges. A principal challenge faced by the ECB pertains to reconciling its environmental objectives with its primary mandate of price stability. Academic debates are ongoing as to whether the ECB should depart from market neutrality in its asset purchases to prioritize green assets.

People’s Bank of China (PBOC)

Incentivized Green Lending. The PBOC has initiated preferential reserve requirements for green loans, incentivizing financial institutions to allocate resources to sustainable projects.

Comprehensive Green Finance Guidelines. The PBOC has pioneered the development of exhaustive green finance guidelines, serving as a model for international implementation.

Global Collaborative Initiatives. The PBOC has been an active participant in international green finance forums, including the G20 Sustainable Finance Study Group.

Challenges. The PBOC faces the implementation hurdle of ensuring the efficacy of green finance initiatives at a regional level, given China’s geographical vastness and regional disparities.

Federal Reserve

Emphasis on Climate Risk Disclosure. Although the Federal Reserve has been somewhat tardy in adopting green finance measures, it has recently accentuated the significance of climate risk disclosures for financial institutions.

Investment in Climate-Related Research. The Federal Reserve has allocated resources to research for understanding the economic repercussions of climate change, yet integration into monetary policy remains pending.

Public-Private Consultative Groups. The Federal Reserve has engaged in dialogues with the private sector through consultative groups to investigate the feasibility of green finance initiatives.

Challenges. Political barriers present a significant challenge for the Federal Reserve in the adoption of green finance strategies, owing to the contentious nature of climate change debates in the United States.

In summary, central banks globally are increasingly acknowledging the imperative of advancing green finance. However, their approaches are distinctly influenced by their specific mandates, regulatory landscapes, and socio-political contexts. Notwithstanding these differences, there exist common elements, such as the utilization of green bonds and stress tests, which afford opportunities for mutual learning and collaborative endeavors.

3.5 Challenges in promoting green finance through central banks

In the discourse on the advancement of green finance, the pivotal role of central banks cannot be overstated. However, these institutions encounter a multifaceted array of challenges that potentially compromise their efficacy in this realm. This section scrutinizes these challenges, compartmentalizing them into four principal domains: political considerations, economic constraints, technological limitations, and regulatory obstacles.

Political Considerations

Policy Alignment Difficulties. Central banks may confront complexities in harmonizing their green finance objectives with overarching political agendas, particularly in nations where environmental sustainability is not prioritized.

Political Polarization Dynamics. In certain jurisdictions, the discourse on climate change is mired in political polarization, thereby constraining central banks from undertaking unequivocal initiatives without incurring political repercussions.

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Public Perception and Mandate Integrity. Central banks must exercise caution to avert the public sentiment that they are transgressing their conventional mandates, as such perceptions could potentially compromise their institutional credibility and independence.

Economic Constraints

Resource Allocation Challenges. Central banks function within set budgetary parameters, which can circumscribe their capacity to invest in green initiatives or promulgate financial stimuli for sustainability projects.

Market Neutrality Dilemma. The pursuit of market neutrality often stands in opposition to the objectives of green finance promotion, given that the latter may necessitate preferential treatment of green assets.

Economic Cycle Influences. The prevailing economic climate can sway the focus of central banks, particularly during economic downturns where immediate concerns may supersede long-term sustainable objectives.

Technological Limitations

Data Availability Concerns. For efficacious policy formulation, robust and comprehensive data sets are indispensable. However, central banks may encounter impediments in acquiring reliable data pertaining to environmental risks and green assets.

Technological Infrastructure Gaps. An absence of sophisticated technological platforms can stymie the effective execution and monitoring of green finance initiatives.

Innovation Deficiencies. Central banks may find themselves lacking the technological acumen necessary for the innovation of new financial instruments tailored for green finance.

Regulatory Hurdles

Regulatory Complexity. The regulatory framework governing green finance is often intricate and disjointed, involving a myriad of stakeholders across multiple jurisdictions.

Standardization Issues. A conspicuous lack of standardized definitions and criteria pertinent to green finance can engender confusion and impede efficacious regulation.

Legal Constraints. Legal limitations may hamper the central banks’ latitude in introducing new regulatory measures, necessitating legislative amendments that are both politically challenging and time-intensive.

In conclusion, central banks hold a substantial but complex role in the advocacy of green finance. Addressing the intricate challenges they face necessitates nuanced, multidimensional solutions that likely require cross-sectoral collaboration and a proclivity for policy and financial instrument innovation.

4 Conclusion

Summary of Key Findings

In the endeavor to elucidate the multifaceted role central banks serve in the facilitation of green finance, this paper has traversed an interdisciplinary landscape, examining historical contexts, theoretical frameworks, and practical mechanisms at the disposal of these financial institutions. Through case studies encompassing the European Central Bank, the People’s Bank of China, and the Federal Reserve, this research offers a nuanced understanding of the divergent strategies and challenges that central banks face, contingent on their unique economic and regulatory milieus.

Challenges and Opportunities. Central banks confront an intricate array of challenges ranging from political considerations to technological inadequacies. Nonetheless, these challenges are offset by considerable opportunities for financial innovation and global collaborative efforts.

Implications for Policy and Practice
Holistic Policy Integration. Central banks are advised to adopt a holistic methodology that amalgamates green finance objectives within their broader monetary and regulatory paradigms.

Transparency and Disclosure Mechanisms. Augmented transparency and disclosure protocols can serve as catalysts, impelling market participants towards sustainable financial practices.

Global Collaborative Ventures. In light of the global implications of climate change, it is incumbent upon central banks to engage in international collaborations to both disseminate best practices and to formulate uniform regulatory frameworks.

Public and Market Participant Engagement. An imperative exists for central banks to initiate dialogues with both the public and market actors to cultivate awareness and consensus on the salience of green finance.

Recommendations for Future Research

Longitudinal Impact Assessment. Subsequent research endeavors should concentrate on the longitudinal evaluation of central bank policies concerning the green finance ecosystem, employing a blend of empirical and theoretical methodologies.

Comparative Financial Instrument Analysis. Research that engages in comparative analyses of various financial tools and regulatory measures will furnish invaluable insights into best practices.

Socio-Economic Variable Exploration. Investigating the socio-economic determinants that modulate the efficacy of central bank policies could yield a more nuanced comprehension of green finance promotion mechanisms.

Technological Innovation Studies. In an era of rapid fintech evolution, scholarly focus on how technological advancements can be leveraged to bolster green finance is of paramount importance.

In summation, the role of central banks in the promulgation of green finance is simultaneously critical and labyrinthine. As custodians of financial stability, these institutions are uniquely positioned to direct capital flows towards sustainable projects. While fraught with challenges—from the navigation of political terrains to the reconciliation of economic and environmental objectives—the potential for impactful transformation is significant.

The urgency of climate change issues elevates the role of central banks from a mere economic dimension to a societal exigency. The transition towards financial sustainability transcends financial feasibility and enters the realm of ethical imperatives. With their extensive influence and instrumentalities, central banks bear not only the capability but also the ethical obligation to spearhead this transition.

In conclusion, this research accentuates the transformative capacity of central banks in sculpting a sustainable future. Despite a pathway strewn with obstacles, the end goal—a symbiosis of financial stability and environmental sustainability—offers a compelling rationale that renders this journey not merely obligatory but also profoundly rewarding.

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