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Probabilistic and Asymmetric Effects of Green Accounting on Economic Prosperity and Economic Downturns Using Bayesian Logistic Regression

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Research Article

Keywords: Green accounting, Economic prosperity, Economic downturn, Bayesian logistic regression, Probabilistic analysis

Posted Date: June 29th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9414125/v1

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Additional Declarations: No competing interests reported.

Abstract

Purpose:

This article aims to explore the impact of green accounting on economic prosperity and economic downturn in 82 countries over the period from 2002 to 2020. At the same time, it examines the extent of the effects of excessive expansion and severe contraction of green accounting across different phases of the economic cycle.

Design/methodology/approach:

The study applies a Bayesian Logistic regression model to provide a more comprehensive and deeper understanding of the impact of green accounting on phases of economic fluctuations.

Findings:

The results indicate that green accounting has a positive effect on economic prosperity, with estimated coefficients ranging from 0.0042 to 0.0049, together with posterior probabilities from 99.92% to 99.99%. In addition, both the expansion and the contraction of green accounting contribute to an increase in economic prosperity, although these effects are only short term. For periods of economic downturn, green accounting shows a mitigating effect, with coefficients ranging from − 0.0014 to -0.0017 and posterior probabilities from 97.78% to 99.99%. However, excessive expansion or severe contraction of green accounting worsens economic downturn, indicating the need to implement green accounting in a balanced and well targeted manner.

Originality/value:

This study contributes by developing a composite measurement framework for green accounting and by examining the asymmetric effects of excessive expansion and severe contraction of green accounting on the economic cycle. In doing so, it provides important practice based policy recommendations.

JEL Classification: Q56, C11, C25, E32.

1. INTRODUCTION

This study explores the impact of green accounting on economic prosperity and economic downturn, while also identifying the probability of these effects in the context of climate change. Facing the risks of the “brown economy”, countries are compelled to expand and adjust appropriate policies to stabilize both the economy and the environment (Stöver, 2016; Wang et al., 2024; Quoc et al., 2025; Hossain et al., 2025). However, achieving this objective requires strong supporting instruments (Rounaghi, 2019; Thanh et al., 2025; Van et al., 2025). In this context, green accounting is considered an important mechanism that helps integrate environmental factors into the economic decision making system, thereby contributing to the reduction of negative shocks and the risk of economic downturn (Wang et al., 2024; Winursito et al., 2026). Unlike traditional accounting, which mainly focuses on financial flows, green accounting expands its scope by integrating the recognition of natural resource values and the costs of environmental depletion and degradation (Bartelmus, 2018; Zhu et al., 2023; Wang et al., 2024). Green accounting refers to initiatives on transparent environmental information disclosure, supporting governments in optimizing management and control efficiency, while clearly distinguishing between “real economic growth” and “artificial growth” (Liu & Liu, 2025; Degirmenci et al., 2025). In addition, the ability to provide reliable information on genuine saving or renewable energy development contributes to reducing information asymmetry in capital markets, thereby attracting international investors, promoting long term growth, and reshaping a non carbon economy. In this context, green accounting not only provides accurate environmental information but also helps control and limit the space for corruption among management entities. This is evidenced by cases of public agencies excessively exploiting energy resources or firms reporting environmental taxes in a non transparent and symbolic

manner. As a result, green accounting helps enhance accountability and strengthen the foundation for sustainable economic growth (Zhu et al., 2023; Wang et al., 2024). Therefore, green accounting is considered an important solution with the capacity to model the economy by shaping the consistency and transparency of environmental information, especially in the context of increasingly severe environmental degradation (El Serafy, 1997; Cairns, 2000; Lodhia & Sharma, 2019; Pramesti & Novita, 2024).

Although green accounting has increasingly become an important factor in improving the quality of economic policy, some empirical evidence indicates that the adoption of green accounting may be associated with economic cycle fluctuations, including periods of economic expansion and economic downturn. A typical case is the Green GDP initiative in China, implemented from 2004, which aimed to adjust traditional GDP by internalizing the costs of pollution and resource depletion. However, incorporating environmental costs into the measurement system significantly reduced the recorded GDP growth rate, estimated at around 3% to 5% of total national GDP in 2006. This situation triggered internal conflicts that affected growth evaluation, thereby aggravating economic and social issues and forcing the initiative to be suspended in 2007. Another example is the encouragement of changes in national development measurement systems through the 17 Sustainable Development Goals SDGs in 2015. Within the 2030 Agenda, it is emphasized that a transformation in the measurement of traditional GDP is required by integrating resources, environmental, and social factors, while promoting social accounting and environmental accounting within the accounting system, thereby contributing to economic expansion. Similarly, the conflict between Russia and Ukraine triggered a global scale energy crisis, thereby reaffirming the role of energy resources in the economy. Russia is considered a major reservoir supplying gas and oil to the world, and when the conflict occurred, the contraction in energy supply created a supply shock that led to rising energy prices. This situation forced many countries to face increasing production costs, resulting in economic downturn. These practical observations indicate that environmental factors and energy resources are closely linked to economic fluctuations.

Recent studies have focused on examining green accounting in the process of sustainability (Rounaghi, 2019; Wang et al., 2024; Thanh et al., 2025; Winursito et al., 2026). However, the relationship between green accounting in economic expansion and economic downturn has not yet been fully explored, especially in the context of constructing national green accounting indices. For example, Pramesti & Novita (2024) show that green accounting is strongly associated with the implementation of economic policies, specifically through transparent disclosure of environmental reports, thereby enhancing sustainable development. Accordingly, promoting green accounting is considered a tool for sustainable development (Ghatak, 2025). Similarly, Maswadeh & Alhusban (2024) emphasize the positive role of green accounting in sustainable development, while also highlighting the supporting potential of environmental technologies. Bartelmus (2018) argues that green accounting helps overcome the limitations of traditional GDP by integrating environmental damage and resource assets, thereby avoiding growth illusions. In addition, Lodhia & Sharma (2019) suggest that green accounting is multidimensional in nature, formed by various factors, and reflects differences in both the level and manner of implementation across countries (Stöver, 2016; Lodhia & Sharma, 2019; Ghatak, 2025; Degirmenci et al., 2025). A clear understanding of the impact of green accounting on phases of economic expansion and economic downturn provides a comprehensive perspective for policy making, helping to assess whether strong or weak implementation of green accounting can promote growth or increase the risk of downturn under conditions of economic volatility. Empirical results support adjustments in national green accounting policies, with a focus on identifying the magnitude of impacts rather than pursuing fully comprehensive targets. Based on these considerations, this study aims to evaluate the impact of green accounting on economic prosperity and economic downturn, while also exploring the probability of these effects occurring under different economic contexts.

To achieve this objective, the use of an appropriate model provides a more accurate perspective, therefore in this paper we employ the Bayesian logistic regression model. Unlike traditional approaches, Bayesian inference allows the integration of additional information through prior distributions, and is particularly more flexible in addressing issues related to small samples, heteroskedasticity, and endogeneity (Gelman & Hill, 2006; Thach, 2020). In addition, this method enables hypothesis testing without relying on rigid assumptions, thereby improving the accuracy and reliability of the results

(Kruschke, 2015; Le Quoc, 2025). Accordingly, it allows probabilistic predictions of the impact of green accounting under different economic contexts.

This study not only provides a nuanced perspective on the impact of green accounting on the economic cycle, but also contributes in four aspects as follows: (1) It contributes to the theoretical foundation regarding the impact of green accounting on economic prosperity and economic downturn. (2) It provides additional empirical evidence examining how the expansion and contraction of green accounting affect the economic cycle, while also exploring the probability of these effects occurring. (3) By applying the Bayesian logistic regression model, the study helps reduce common limitations of traditional methods, especially in the context of small samples and highly uncertain economic data. (4) It offers relevant policy implications to optimize benefits or better control green accounting in a context of economic volatility.

2. LITERATURE REVIEW

2.1. Theoretical framework

Sustainable Development Theory was initiated by the World Commission on Environment and Development WCED of the United Nations in the Brundtland Report (1987). This theory emphasizes the balance among three pillars, including economic growth, environmental protection, and social equity. Accordingly, economic growth based on the depletion of natural capital may generate prosperity in the short term, but it weakens the foundation of sustainable development, thereby increasing the risk of economic downturn in the long term. Within this framework, green accounting is approached as a tool to measure and reallocate natural capital within the economic system. Specifically, GA, by internalizing environmental costs and correcting distortions of the traditional GDP indicator, supports policy formulation in a direction that limits artificial growth and reduces the risk of economic recession. However, the effectiveness of green accounting depends significantly on the level of implementation. Excessive expansion of green accounting beyond a reasonable threshold may increase adjustment costs and restrain economic growth in the short term. In contrast, narrowing or neglecting green accounting may increase the risk of economic downturn due to negative impacts from environmental degradation and resource depletion.

Environmental Kuznets Curve Theory was developed by Grossman & Krueger (1995) based on the traditional Kuznets Curve theory proposed by Kuznets (1955). This theory is extended to the environmental field, emphasizing that there exists an inverted U shaped relationship between environmental quality and economic development. Green accounting is approached through transparent disclosure of environmental information, such as resources, energy, emissions, thereby contributing to the reduction of information asymmetry and supporting investors in better risk valuation. In addition, limiting GA can also promote economic growth through flexibility in implementation and compliance. However, during periods of economic downturn, green accounting plays a strong role in reducing the risks of environmental shocks, supporting the design and adjustment of policies aimed at achieving sustainable goals and mitigating economic recession. At the same time, excessive disclosure may lead to information noise, causing markets to react strongly to negative information and thereby worsening economic contraction. In contrast, severe restriction of green accounting results in environmental information not being fully reflected, delaying policy adjustments to limit risks and thereby increasing the likelihood of economic recession.

Adaptive Governance Theory was proposed by Dietz & coauthors (2003), which emphasizes that to build an effective governance system it is necessary to have continuous learning capacity, timely policy adjustment, and flexible responses to environmental and economic risks. Within this theoretical framework, green accounting plays the role of an input information system for the governance process, through providing early warning signals of environmental risks and enhancing transparency in information sources such as adjusted net savings or compliance with environmental taxes, while also reducing the space for corruption and improving accountability.

Accordingly, GA helps reduce delays in government and market responses and improves the rate of economic growth. In the context of economic recession, GA contributes to identifying potential risks, limiting extreme policy responses, and supporting economic stability, thereby reducing the probability of recession. However, excessive use of GA may lead to information overload, causing difficulties in information processing and leading governance systems to adjust policies in a rushed and selective manner. In contrast, severe limitations on green accounting result in risks not being detected in a timely manner, leading to slow and mainly compensatory policy responses, thereby increasing the likelihood of economic downturn.

2.2. Green accounting and economic expansion and economic downturm

Research on the impact of green accounting on economic prosperity and economic downturn remains incomplete. At the same time, the measurement of green accounting in previous studies still shows many limitations, mainly focusing on single aspects such as resource consumption, pollution emissions, or policy instruments such as environmental taxes. Therefore, the role of green accounting has increasingly attracted attention in modern economic research. From this perspective, Bartelmus (2018) emphasizes the importance of green accounting for economic stability through enhancing environmental information transparency, improving resource use efficiency, and limiting excessive exploitation. At the same time, green accounting mechanisms help address the shortcomings of traditional GDP, thereby creating conditions for promoting long term economic prosperity. Lodhia & Sharma (2019), through a systematic review of related studies, argue that green accounting makes a positive contribution to sustainable economic development. The results indicate that reforming accounting systems toward the integration of environmental and social factors helps provide more comprehensive information for stakeholders, thereby supporting economic growth. Ali et al. (2023) examine the relationship between renewable energy consumption (REC), non renewable energy consumption (NREC), CO_2 emissions, and economic growth in Asia during the period 1975 to 2022. By applying the AMG estimation technique combined with the Dumitrescu–Hurlin causality test, the study shows that both REC and NREC have positive effects on economic growth in the long run. However, REC contributes to reducing carbon emissions, while NREC has the opposite effect. In addition, economic growth and environmental degradation exhibit a nonlinear N shaped relationship according to the Environmental Kuznets Curve (EKC) theory, and there exists a bidirectional causal relationship between REC and economic growth. Maswadeh & Alhusban (2024) analyze the impact of green accounting on sustainable development, while also examining the moderating role of environmental technology. Using panel data and multiple regression models, the results show that green accounting promotes economic growth in a sustainable direction, while environmental technology plays a key role in amplifying this effect. Similarly, using a qualitative approach, Pramesti & Novita (2024) synthesize studies related to green accounting and sustainable development, showing that higher levels of transparency in environmental reporting help stakeholders design more effective policies, thereby promoting green economic growth. Degirmenci et al. (2025) employ CS-ARDL and CS-DL models to analyze the impacts of green innovation, human capital quality, the transition to renewable energy, and environmental policies on sustainable development in OECD countries. The results indicate that green innovation and renewable energy have positive effects, while strict environmental policies have not achieved the expected effectiveness. Zhu et al. (2023) examine the role of accounting for pollution and resource depletion costs within sustainable development strategies. Using the SEEA 2012 framework and a BP neural network model, the study finds a nonlinear relationship between environmental pollution and economic growth, with stronger negative effects in highly polluted countries. The results indicate that green accounting contributes to improving environmental quality and reducing climate related pressures. Lu et al. (2024) analyze the effects of environmental regulatory instruments on economic growth across 30 Chinese provinces over the period 2009 to 2021, employing fixed effects and threshold models. The findings show that market based instruments, including carbon taxes and emissions trading schemes, have a positive impact on economic growth.

Regarding the mechanisms that may lead to economic downturn, inappropriate and weakly controlled implementation of green accounting can generate negative effects on the economy. Specifically, applying GA too rapidly while institutional

frameworks and monitoring mechanisms are not yet fully developed may lead to information saturation and a decline in the reliability of environmental data, thereby increasing economic instability. In addition, inconsistency in GA implementation may cause international investors to shift toward short term investment strategies, reducing long term capital flows that support sustainable growth. Moreover, excessive and poorly controlled application of GA may create imbalances in resource and energy management and at the same time expand opportunities for corruption in the public private sector, thereby increasing the risk of economic recession. Empirical evidence has partly supported these arguments. Cheng et al. (2020) analyze the impact of natural resources on green oriented economic growth in 30 provinces of China during the period 2003 to 2016 using panel data models. The results show that natural resource abundance tends to hinder green economic growth, reflecting the phenomenon of the resource curse. Tchapchet Tchouto et al. (2022), using panel data from 31 European countries over the period 2009 to 2019 and applying Pooled OLS, GMM, and quantile regression methods, find that environmental taxes have a negative effect on economic growth. However, the magnitude of this effect differs significantly across low income, middle income, and high income countries, implying that the effectiveness of environmental policy instruments largely depends on the level of economic development. Meanwhile, Zheng & Chen (2024) emphasize that traditional GDP does not fully reflect the depletion of natural resources and environmental degradation. The study proposes integrating environmental factors into the national accounting system in order to more accurately measure sustainable development objectives. The results show that the growth rate of green GDP (GGDP) is significantly slower than that of traditional GDP, thereby reflecting previously ignored environmental costs and potentially increasing short term adjustment pressure on the economy.

Accordingly, we propose the following two expected hypotheses:

H1. GA positively affects economic prosperity.

H2. GA reduces economic downturn.

By reviewing the above literature, we identify several gaps in understanding how green accounting influences periods of economic prosperity and economic downturn.

First, prior studies have mainly focused on the relationship between green accounting or environmental proxy variables and economic growth, while the asymmetric effects of green accounting on economic prosperity and economic downturn have not been sufficiently explored. In addition, the construction of green accounting has largely relied on single indicators such as CO2 emissions, energy consumption, natural resource extraction, or environmental taxes to represent green accounting. These approaches do not fully capture the fragmented nature of GA. This study addresses this gap by constructing a composite green accounting index and examining its impact on fluctuations in the economic cycle.

Second, regarding research methods, most previous studies have employed frequentist approaches such as GMM, CS ARDL, CS DL, AMG, or conventional OLS regression models. However, testing the research hypotheses requires methods that are more consistent with real world conditions in order to provide reliable inferences rather than relying on strict assumptions. Although the advantages and limitations of Bayesian methods have been discussed in earlier studies, a key strength lies in their explanatory power being less dependent on sample size. Moreover, Bayesian approaches help reduce sensitivity to common model problems such as autocorrelation, heteroskedasticity, and endogeneity issues (Gelman, 2004; Dinh et al., 2024; Nguyen The et al., 2024). In this study, we apply a Bayesian Logistic regression model to explore the impact of green accounting on different phases of economic fluctuations by testing and analyzing the hypotheses more accurately, while minimizing the influence of unrealistic assumptions. As a result, the study provides practical and reliable insights into the relationship between green accounting, economic prosperity, and economic downturn.

3. METHODOLOGY

3.1. Explanation of variables and construction of green accounting using the PCA method

The research data are compiled based on availability and are collected from two main sources: (1) the World Development Indicators (WDI) published by the World Bank; and (2) the Organisation for Economic Co operation and Development (OECD). The Principal Component Analysis (PCA) technique is applied to compute and construct the green accounting index based on relevant component variables.

The construction of economic prosperity and economic downturn variables is based on an interpretation following a binary approach to average economic growth levels. Specifically, the economic prosperity variable takes the value of 1 in years when the economic growth rate exceeds the average level, while it takes the value of 0 to reflect the remaining cases. The economic downturn variable takes the value of 1 in years when the economic growth rate is negative, and 0 represents other cases. The advantage of this analytical approach lies in providing an empirical basis for assessing and examining the impact of green accounting on economic fluctuations, thereby offering policymakers more appropriate strategic guidance, especially in a context where the economy is frequently exposed to instability.

Green accounting, by providing information on energy resources, green expenditures, the internalization of environmental damage costs, and transparency in environmental taxation, helps reduce the space for corruption and enhance the effectiveness of resource control and management. However, Lodhia & Sharma (2019) argue that green accounting is clearly fragmented in nature, as it cannot be measured by a single specific indicator but is instead aggregated from multiple related components that explain and justify particular aspects of green accounting (Wang et al., 2024; Thanh et al., 2025; Ghatak, 2025). In this study, we construct green accounting based on 16 component variables (*Table I*).

The component variable diagram calculated using R software clearly illustrates the correlation structure, in which many components move in the same direction. For example, variables related to emissions, extraction, and resource depletion such as FEC, CRNW, DPEM, DCO2, DFOR, PRIM, TOTL, and DRES show strong positive correlations, implying a substantial degree of information overlap among these variables. In contrast, the environmental protection policy variable such as TAX exhibits an opposite correlation, reflecting regulatory efforts to mitigate the level of environmental degradation (Fig. 1). With such a systematic correlation structure, the assumption of independence among variables is unreliable. Therefore, the PCA technique is robust in allowing linear construction so that variables are uncorrelated, reducing data dimensionality, aggregating information, and avoiding multicollinearity when constructing the green accounting measurement index, while transforming the model from complex to more analytically tractable (Bro & Smilde, 2014). In essence, PCA is defined as an orthogonal linear transformation in which the original data are represented in a coordinate space ordered by decreasing variance. The principal components are aggregated according to the orthogonality principle, with each set being independent through the transformation of correlated datasets. The first principal component captures the largest share of explained variance, representing the dominant direction of data influence and being formed from linear combinations. All components reproduce most of the original information and are completely independent and uncorrelated with each other (Lamichhane et al., 2021).

Source: Authors' own elaboration

Given this situation, if the explained variance ratio of the first principal component (PC_1) is greater than 70% and the eigenvalue is greater than 1, PC_1 is retained to construct the composite index variable. However, when PCA results yield multiple principal components (PCs), the construction of the composite index is calculated based on the weights (W) of the PCs. In this case, the explained variance ratios of the PCs are used to determine the weights (W) assigned to each PC (Kurniawan et al., 2025). The cut off point for retaining components is identified at eigenvalues greater than 1 and a cumulative explained variance exceeding 70% (Jain & Mohapatra, 2023; Thanh et al., 2025). Table 1 presents the results of the PCA analysis, summarizing the main insights. The variables are extracted into five principal components, each with an

eigenvalue greater than 1, and the total explained variance reaches 74.70%. In this context, relying solely on PC_1 (31.31%) would result in a substantial loss of information in constructing green accounting. Therefore, this study constructs a composite green accounting measurement index by combining five principal components to reflect the explanatory level of green accounting in transparent environmental information disclosure and in enhancing the effectiveness of environmental control and management.

Table 1
Explanatory contribution of component variables

Components	Eigenvalue	Explained variance	Cumulative
Component 1	5.00986	0.3131	0.3131
Component 2	2.81987	0.1762	0.4894
Component 3	1.78479	0.1115	0.6009
Component 4	1.24573	0.0779	0.6788
Component 5	1.09151	0.0682	0.7470
Component 6	0.93608	0.0585	0.8055
Source: Authors' compilation			

In this context, retaining principal components that satisfy the conditions helps capture most of the explanatory information for the green accounting measurement index. The retained PCs are aggregated using weights to construct a single green accounting scale, in which the explained variance ratio corresponding to each PC is used as the weight (Fernandez & Martos, 2020; Zheng & Chen, 2024). In addition, before aggregating green accounting, orienting the signs of the PCs is necessary to ensure that all PCs are consistent in the interpretation of greening (Jain & Mohapatra, 2023). Orienting the PCs according to a good criterion or a positive policy signal does not alter the properties of PCA, but instead supports consistent interpretation and correctly reflects the direction of greening (Boudt et al., 2022).

Based on this, the general formula for aggregating the component PCs is defined as follows:

$$CI = \sum_{i=1}^{k} \pi_i Y_i$$

Where, *CI* denotes the composite index, π_i represents the weight reflecting the explanatory contribution of the principal component PC_i; *k* is the number of retained principal components; and Y_i is the value of the principal component PC_i used to construct the composite index.

Based on this reasoning, the GA score is calculated using the following formula:

$GA = 0.3131PC_1 + 0.1762PC_2 + 0.1115PC_3 + 0.0779PC_4 + 0.0682PC_5$

In addition, to provide a deeper assessment of the impact of green accounting on the economic cycle, this study conducts supplementary analysis by examining excessive expansion and excessive contraction of green accounting in relation to economic expansion and economic downturn. Specifically, a dummy variable is constructed for excessive expansion, where GAH1 takes the value of 1 when the green accounting index exceeds the mean plus 1.5 standard deviations. Similarly, the dummy variable for severe contraction of green accounting takes the value of 1 when the green accounting index falls below the mean minus 1.5 standard deviations. Next, to assess the influence of excessive expansion and severe contraction of green accounting on the economic cycle, two interaction variables related to green accounting are proposed, namely GAH1_GA and GAH2_GA. The significance of this approach lies in capturing deeper insights under

conditions of excessive expansion and severe contraction of GA, thereby supporting more appropriate policy formulation in green accounting implementation strategies.

In addition to the main variables, this study employs five control variables that play an important role in reducing estimation bias and enhancing the reliability of the results, including the urbanization rate (UR), unemployment rate (UNE), trade openness (TRADE), inflation rate (INF), and foreign direct investment.

3.2. Bayesian logistic regression method

Baseline models examining the impact of GA on economic prosperity and economic downturns are specified as follows:

$EE_{i,t} = \beta_o + \beta_1 GA_{i,t} + \beta_x X_{i,t} + \varepsilon_{i,t}$ (1)

$ED_{i,t} = \beta_o + \beta_1 GA_{i,t} + \beta_x X_{i,t} + \varepsilon_{i,t}$ (2)

However, in models (1) and (2), several issues arise such as autocorrelation, heteroskedasticity, and multicollinearity, which, if not properly addressed, may lead to bias and result in unreliable research findings. In addition, the dependent variables in the models, namely EE and ED, are binary variables, meaning that they take only two possible values. Therefore, this study estimates the models using the Bayesian Logistic regression approach, as Bayesian logit techniques are robust in explaining binary outcomes. Moreover, the Bayesian logistic model offers advantages in providing prior distributions and addressing uncertainty within the model, thereby improving the accuracy and reliability of the research results.

From a Bayesian perspective, the model is specified as follows:

$y_i \sim Bernoulli(p_i)$ (3)

The value y_i is assumed to follow a Bernoulli distribution with success probability p_i. The output variables are posterior distributions determined based on Eq. (4) after removing normalization constants that do not depend on β.

$P(\beta \mid y,X) \propto P(y \mid \beta,X)P(\beta)$ (4)

In this context, Bayesian techniques allow the incorporation of prior information described through probability distributions of the parameters of interest, thereby deriving posterior distributions while reducing the influence of sample size and mitigating the limitations of small samples (Van et al., 2025; Quoc et al., 2025). In contrast to frequentist methods, which assume that observations are randomly repeated and parameters are fixed but unknown, results are derived from statistical properties or sampling distributions of the data. Therefore, sample size plays a decisive role in statistical inference. Meanwhile, Bayesian inference adopts the view that observed samples are fixed and parameters are treated as random variables. Posterior distributions are extracted based on both observed data and prior distributions, thereby providing characteristics based on conditional distributions. In addition, Bayesian techniques effectively mitigate issues related to endogeneity and autocorrelation and offer greater model stability in small sample settings (Van et al., 2025).

When examining the impact of green accounting on periods of economic prosperity and economic downturn, Bayesian regression operates as follows. First, prior assumptions are specified with expected coefficient values equal to 0 and following a normal distribution. This implies that coefficients estimated through Bayesian inference tend to shrink toward 0 rather than deviate from 0, thereby reducing potential positive or negative bias in the results. Second, the likelihood functions of the coefficients are assumed to follow a normal distribution with values determined from equations (1) and (2). Third, the study employs Markov Chain Monte Carlo (MCMC) convergence estimation and the Gibbs Sampler algorithm under the assumption of random sampling. The simulation is conducted for 20.000 iterations, with the first 2.500 iterations discarded according to standard modeling practice. The MCMC technique is widely used to optimize complex models (Levy, 2020).

4. RESEARCH RESULTS

4.1. Overview of descriptive statistics

The descriptive statistics for the sample of 82 countries over the period from 2002 to 2020 are presented in Table 2. Economic prosperity (EP) has a mean value of 0.51347 and a standard deviation of 0.49997, indicating substantial heterogeneity across countries. Bangladesh records the highest frequency of prosperous phases, with 19 periods of economic expansion during the sample period. For economic downturn (ED), the mean value is 0.12772 with a standard deviation of 0.33389, suggesting that downturn episodes occur less frequently but vary considerably across countries. Argentina experiences the greatest number of downturn episodes, totaling eight periods. The green accounting index GA is constructed as a standardized measure to capture the extent of green accounting implementation. The mean value of GA is 24.07%, with a standard deviation of 12.38%, implying that the adoption of green accounting remains relatively limited and uneven across countries. Singapore records the lowest value at 0%, indicating the absence of green accounting implementation, whereas Gabon exhibits the highest level, with green accounting adoption approaching 100%.

Table 2
Descriptive statistics for variables

Variables	Mean	Std. Dev	Minimum	Maximum	Pesaran CD Test	Jarque-Bera Test
EP	0.51347	0.49997	0.00000	1.00000	0.00000***	0.00000***
ED	0.12772	0.33389	0.00000	1.00000	0.00000***	494.830***
GA	24.07324	12.38367	0.00000	100.0000	21.86900***	528.530***
INF	4.70460	6.37966	-18.8992	85.35328	41.74500***	0.00000***
UNE	7.68487	5.33135	0.31600	32.94400	21.19800***	362.430***
TRADE	84.03821	48.92215	20.44712	437.3267	42.74700***	756.890***
UR	62.53213	20.36327	15.62600	100.0000	0.00000***	69.9100***
FDI	5.77650	21.90445	-296.013	431.7885	26.15300***	0.00000***
VIF Test						
Maximum: VIF of variables				1.14000		
Maximum: 1/VIF of variables				0.98035		
Mean VIF				1.07000		
*Note: *** indicates a significance level of 1%.*						
Source: Authors' compilation						

Several issues stand out in Table 2 that require consideration and correction. The first is the suspicion of cross sectional dependence. To test this, we apply the Pesaran (2021) test, and the results show that all variables are statistically significant ($p < 0.01$), confirming the existence of cross sectional dependence. Next, the Jarque–Bera normality test rejects the null hypothesis H_0 ($p < 0.01$), indicating that the data do not follow a normal distribution. In addition, the maximum VIF values of the variables as well as the average VIF are all below 2 and well under the warning threshold of 10. These results indicate that there is no serious multicollinearity problem.

4.2. Logistic Bayesian results

This study explores the impact of green accounting on global economic expansion and economic downturn over the period from 2002 to 2020, while also identifying the probabilities associated with these effects. The regression results are summarized in Table 3 and Table 4, and the findings provide several noteworthy insights.

Table 3 presents the impact of green accounting on economic prosperity (EP). The results show that green accounting has a positive effect across all models. In particular, neither excessive expansion nor severe contraction of green accounting changes the direction of its positive impact on economic promotion, with posterior probabilities of these effects reaching 99.99% in model (1), 99.92% in model (2), and 99.99% in model (3). These posterior probabilities are reported in Table 5. These results indicate that transparency in environmental information helps create space for economic growth. When market confidence is strengthened, it facilitates the attraction of international investors and provides capital resources that enhance economic quality. In addition, green accounting supports more efficient resource allocation, enabling firms to access a wider range of financial resources and expand their scale of operations. Moreover, GA helps reduce corruption space within public entities through transparency mechanisms, thereby limiting negative factors affecting the economy and supporting sustainable development. These findings are consistent with previous studies such as Bartelmus (2018), Lodhia & Sharma (2019), Maswadeh & Alhusban (2024), and Degirmenci et al. (2025). At the same time, the results strongly reinforce the view that adopting green accounting expands transparent environmental information markets, improves resource management efficiency, and promotes sustainable development. In addition, columns (2) and (3) reflect the results for the variables GAH1_GA, representing excessive expansion of green accounting, and GAH2_GA, representing restricted application of green accounting. The mean coefficients of both variables are positive, with GAH1_GA showing a notably small mean value of 0.0002. This suggests that when GA develops excessively beyond a reasonable threshold, its positive effect gradually weakens. This implies that excessive GA leads to over disclosure, which distorts information and reduces market confidence, while also weakening accountability in public and private entities, thereby reducing its contribution to economic prosperity. However, the probability of this outcome is 66.96% as reported in Table 5. Furthermore, limiting green accounting may still support economic growth, but this effect is short term in nature and follows a brown growth trajectory. These findings strongly support the hypotheses established earlier under Sustainable Development Theory (Brundtland, 1987), Environmental Kuznets Curve Theory (Grossman & Krueger, 1995), and Adaptive Governance Theory (Dietz et al., 2003), all of which emphasize the importance of green accounting for the economic cycle.

Table 4 reports the impact of green accounting on economic downturn (ED). The results reflect an inverse relationship, in which GA has a negative effect on economic downturn, with posterior probabilities ranging from 97.78% to 99.99% as shown in Table 5. This finding highlights the importance of green accounting for economic stability. Through its ability to contribute to the economy via the mechanisms discussed above, green accounting emerges as a key instrument for promoting sustainability. These results are consistent with the studies of Cheng et al. (2020), Tchapchet Tchouto et al. (2022), and Zheng & Chen (2024), which emphasize that green accounting reduces traditional GDP, thereby reflecting previously ignored environmental costs. A notable point is that both excessive expansion of green accounting (GAH1_GA) and severe contraction of green accounting (GAH2_GA) worsen economic outcomes. Specifically, the variable GAH1_GA has a positive coefficient (0.01826), indicating a very small positive relationship with economic downturn. This suggests that excessive and weakly controlled disclosure may create space for corruption, thereby harming the economy. In contrast, the variable GAH2_GA, representing insufficient application of green accounting, has a stronger effect on economic downturn with a positive coefficient (0.06604) and a posterior probability of impact of 71.5% as reported in Table 5. This finding implies that inappropriate or inadequate implementation of green accounting can increase the risk of economic downturn.

Table 3. EP research results

Variables	Dependent Variable: EP								
	(1)			(2)			(3)		
	Mean	Std. Dev.	MCSE	Mean	Std. Dev.	MCSE	Mean	Std. Dev.	MCSE
Cons	0.78443	0.05717	0.00023	0.78967	0.06629	0.00027	0.79326	0.05662	0.00023
UR	-0.00753	0.00060	0.00000	-0.00754	0.00060	0.00000	-0.00783	0.00060	0.00000
TRADE	0.00129	0.00024	0.00000	0.00129	0.00025	0.00000	0.00118	0.00025	0.00000
FDI	0.00084	0.00054	0.00000	0.00084	0.00054	0.00000	0.00090	0.00054	0.00000
UNE	-0.00740	0.00221	0.00000	-0.00744	0.00221	0.00000	-0.00710	0.00219	0.00000
INF	0.00784	0.00188	0.00000	0.00782	0.00189	0.00000	0.00757	0.00188	0.00000
GA	0.00441	0.00100	0.00000	0.00421	0.00169	0.00000	0.00489	0.00100	0.00000
GAH1_GA				0.00020	0.00129	0.00000			
GAH2_GA							0.10910	0.02556	0.00010
Acceptance rate	1.0000			1.0000			1.0000		
Efficiency: min	0.9738			0.9981			0.9921		
Max Gelman–Rubin Rc	1.0000			1.0000			1.0000		

Source: Authors' compilation

Table 4. ED research results

Variables	Dependent Variable: ED								
	(1)			(2)			(3)		
	Mean	Std. Dev.	MCSE	Mean	Std. Dev.	MCSE	Mean	Std. Dev.	MCSE
Cons	0.03559	0.04111	0.00016	0.04210	0.04431	0.00018	0.03224	0.04111	0.00016
UR	0.00156	0.00043	0.00000	0.00157	0.00043	0.00000	0.00160	0.00043	0.00000
TRADE	-0.00030	0.00017	0.00000	-0.00032	0.00018	0.00000	-0.00027	0.00018	0.00000
FDI	0.00017	0.00039	0.00000	0.00016	0.00039	0.00000	0.00015	0.00040	0.00000
UNE	0.00658	0.00158	0.00000	0.00658	0.00158	0.00000	0.00651	0.00158	0.00000
INF	0.00050	0.00135	0.00000	0.00048	0.00135	0.00000	0.00051	0.00135	0.00000
GA	-0.00140	0.00072	0.00000	-0.00171	0.00108	0.00000	-0.00145	0.07679	0.00000
GAH1_GA				0.01826	0.04693	0.00019			
GAH2_GA							0.06604	0.03298	0.00032
Acceptance rate	1.0000			1.0000			1.0000		
Efficiency: min	0.9738			0.9981			0.9921		
Max Gelman–Rubin Rc	1.0000			1.0000			1.0000		

Source: Authors' compilation

Table 5. Posterior probability of the occurrence of variable effects

Probability of occurrence	Dependent Variable: EP								
	(1)			(2)			(3)		
	Mean	Std. Dev.	MCSE	Mean	Std. Dev.	MCSE	Mean	Std. Dev.	MCSE
{EP:Cons} > 0	1.00000	0.00000	0.00000	1.00000	0.00000	0.00000	1.00000	0.00000	0.00000
{EP:UR} < 0	1.00000	0.00000	0.00000	1.00000	0.00000	0.00000	1.00000	0.00000	0.00000
{EP:TRADE} > 0	0.99999	0.00034	0.00000	0.99999	0.00024	0.00000	0.99999	0.00610	0.00006
{EP:FDI} > 0	0.93665	0.24358	0.00243	0.94226	0.23324	0.00233	0.95220	0.21332	0.00213
{EP:UNE} < 0	0.99962	0.01928	0.00020	0.99965	0.01866	0.00018	0.99940	0.02435	0.00024
{EP:INF} > 0	0.99998	0.00429	0.00004	0.99998	0.00394	0.00003	0.99997	0.00532	0.00005
{EP:GA} > 0	0.99999	0.00237	0.00002	0.99927	0.02709	0.00027	0.99999	0.00024	0.00000
{EP:GAH1_GA} > 0				0.66960	0.47035	0.00470			
{EP:GAH2_GA} > 0							0.99999	0.00313	0.00003

Probability of occurrence	Dependent Variable: ED								
	(1)			(2)			(3)		
	Mean	Std. Dev.	MCSE	Mean	Std. Dev.	MCSE	Mean	Std. Dev.	MCSE
{EE:Cons} > 0	0.80457	0.39652	0.00396	0.88090	0.32389	0.00324	0.82764	0.37769	0.00377
{EE:UR} > 0	0.99985	0.01195	0.00011	0.99990	0.00996	0.00009	0.99984	0.01250	0.00013
{EE:TRADE} < 0	0.96119	0.19313	0.00193	0.96662	0.17961	0.00179	0.93319	0.24968	0.00249
{EE:FDI} > 0	0.65919	0.47398	0.00473	0.63055	0.48265	0.00482	0.70021	0.45816	0.00458
{EE:UNE} > 0	0.99998	0.00400	0.00004	0.99998	0.00333	0.00003	0.99998	0.00453	0.00005
{EE:INF} > 0	0.64068	0.47979	0.00479	0.63891	0.48031	0.00480	0.63891	0.48031	0.00480
{EE:GA} < 0	0.99999	0.00217	0.00002	0.98070	0.13756	0.00137	0.97778	0.14737	0.00147
{EE:GAH1_GA} > 0				0.85655	0.35052	0.00350			
{EE:GAH2_GA} > 0							0.71505	0.45138	0.00451

Source: Authors' compilation

The Bayesian model uses 20.000 MCMC simulations with regression coefficients generated through the Gibbs Sampling algorithm. Model results are evaluated using posterior means, standard deviations, and MCSE. Following Flegal et al. (2008), good convergence requires MCSE to approach 0 and remain below 5% of the Std. Dev, with an acceptable upper bound of 6.5%. Model diagnostics reported in Table 3 and Table 4 show an average acceptance rate of 1.0000, exceeding

the minimum threshold of 0.5, while the lowest efficiency value is 0.9738, well above 0.01 (Nguyen The et al., 2024). In addition, MCSE values are very small across all variables, and the maximum $\widehat{\mathrm{Rc}}$ equals 1, below the critical value of 1.1 (Levy, 2020). These results confirm good MCMC convergence, model stability, and reliable Bayesian estimates.

5. CONCLUSION

This study discusses the impact of green accounting on economic prosperity and economic downturn, based on a dataset of 82 countries over the period 2002 to 2020. The investigation is conducted using the Bayesian Logistic regression model, and the findings provide in depth insights into the importance of green accounting for economic development, as well as policy directions to mitigate economic downturn. The study opens a new accounting perspective by integrating energy resources and internalizing environmental costs, thereby shaping the potential transformation of the economy toward sustainable development. The significance of this issue is reinforced through the clarification of the four aspects discussed above, on the basis of which we propose several recommendations to optimize the benefits of green accounting.

For the period of economic expansion, the results indicate that green accounting has a positive effect on economic expansion, with coefficients ranging from 0.00421 to 0.00489. Notably, regardless of whether green accounting is excessively expanded or restricted, the effects remain positive. This implies that promoting the implementation of green accounting is one of the key strategies for stabilizing and developing the economy. Accordingly, governments should expand and enhance accounting information systems to strengthen transparency in information disclosure. In addition, in the context of rapid digital transformation, it is necessary to integrate technology into management practices, while developing systems to control resources, energy, environmental taxes, and the internalization of environmental damage costs. These measures help improve information efficiency and reduce corruption space within public private entities, thereby supporting long term economic growth.

For periods of economic downturn, the Bayesian Logit results show that green accounting contributes to reducing economic downturn, with effect sizes ranging from 0.00140 to 0.00171. This highlights the important role of green accounting in enhancing economic stability. However, excessive expansion or severe contraction of green accounting increases the risk of economic downturn, implying that green accounting should be applied in a focused and appropriate manner, avoiding overuse that may lead to economic stagnation. Therefore, governments should issue suitable green accounting adjustment policies, shifting the focus from expansion to refinement, and integrating green accounting into the national accounting system to enhance environmental management effectiveness. At the same time, it is necessary to encourage and support green industries to promote green economic development. Governments should also limit brown public spending and instead redirect spending toward green public investment in green infrastructure and green technologies, while expanding investment in green enterprises to increase production scale, limit artificial growth, and move toward sustainable development.

Nevertheless, the study still has several gaps that have not been addressed, such as the role of macroeconomic factors, unexpected economic shocks, or other components shaping green accounting such as green investment. In addition, the study does not conduct separate analyses by region, such as Africa, Asia, or Europe. Therefore, future research may narrow the sample scope by region to compare differences in the impact of green accounting on the economy, while also applying more diverse analytical models and constructing alternative measurement scales to provide a more comprehensive perspective on green accounting.

DECLARATIONS

Acknowledgements

The authors would like to thank the anonymous reviewers and the Editorial Board for their valuable comments and constructive suggestions, which have greatly improved the quality of this manuscript. Any remaining errors are the sole responsibility of the authors.

Funding

This research was funded by Lac Hong University.

Clinical trial number

Not applicable.

Contributions

H.N.V: Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Supervision, Writing – original draft, Writing – review & editing. T.T.D: Data curation, Validation, Visualization, Resources, Software, Writing – review & editing.

Competing interests

The authors declare no competing interests.

Consent for publication

Not applicable.

Ethical approval and consent to participate

Not applicable.

Consent to Participate

Not applicable.

Consent for Publication

Not applicable.

Data availability

The datasets analyzed during the current study are available from publicly accessible repositories. The data were compiled from two primary sources: (1) the World Development Indicators (WDI) published by the World Bank (https://databank.worldbank.org), and (2) the Organisation for Economic Co-operation and Development (OECD) database (https://stats.oecd.org).

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Figures

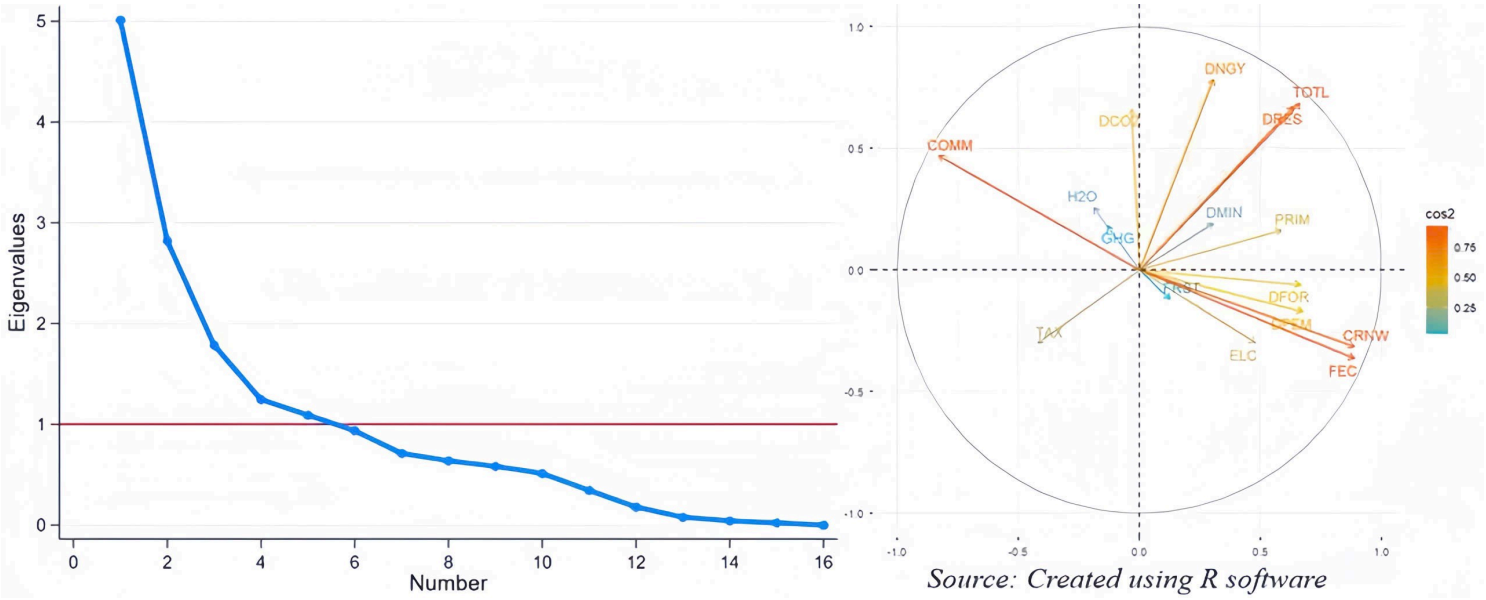


Figure 1

PCA eigenvalues and explanatory quality of component variables

Source: Authors' own elaboration

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