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CLIMATE CHANGE AND GREEN ECONOMY: PROPOSING A SUSTAINABLE MACROECONOMIC MODEL

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Abstract. This study explores the interrelationship between climate change and economic development, emphasizing the need for a transition toward a green economy. The research proposes a sustainable macroeconomic model that integrates environmental, economic, and social dimensions into a unified framework. Using a mixed-method approach, the study analyzes the impact of green investment, carbon pricing, renewable energy, and policy interventions on economic growth and environmental sustainability. The findings demonstrate that incorporating ecological factors into macroeconomic models enhances long-term stability, promotes innovation, and reduces environmental degradation. The proposed model provides practical guidance for policymakers to achieve sustainable and inclusive development in the context of global climate challenges.

Keywords: climate change, green economy, sustainable development, macroeconomic model, green investment, carbon pricing, renewable energy, environmental sustainability.

Introduction. In recent decades, the accelerating pace of climate change has emerged as one of the most critical global challenges, posing significant risks to economic stability, environmental sustainability, and social welfare. Rising global temperatures, increasing frequency of extreme weather events, biodiversity loss, and resource depletion are reshaping the foundations of traditional economic systems. These developments have exposed the limitations of conventional growth models that prioritize short-term economic expansion over long-term ecological balance.

At the same time, the concept of the green economy has gained increasing attention among policymakers, researchers, and international organizations as a viable pathway toward sustainable development. A green economy emphasizes low-carbon growth, efficient resource utilization, environmental protection, and social inclusiveness. It seeks to decouple economic growth from environmental degradation while promoting innovation, resilience, and equitable distribution of resources.

Despite growing consensus on the need for sustainable transformation, many existing macroeconomic models remain inadequate in addressing the complex interactions between economic activity and environmental systems. Traditional macroeconomic frameworks often neglect ecological constraints, undervalue natural capital, and fail to incorporate climate-related risks into economic planning and policy design. As a result, there is a pressing need to develop a sustainable macroeconomic model that integrates environmental considerations into core economic structures.

This study aims to propose a comprehensive macroeconomic model that aligns economic growth with environmental sustainability and climate resilience. The proposed model incorporates key elements such as green investment, carbon pricing mechanisms, renewable energy transition, and sustainable consumption patterns. It also emphasizes the role of

government policies, technological innovation, and institutional frameworks in facilitating the transition toward a low-carbon economy.

Furthermore, the research seeks to contribute to the theoretical and practical discourse on sustainable development by bridging the gap between environmental economics and macroeconomic policy design. By integrating climate change mitigation and adaptation strategies into macroeconomic modeling, this study provides a foundation for more resilient and future-oriented economic systems.

Ultimately, the relevance of this research lies in its potential to support policymakers in designing effective strategies that ensure long-term economic prosperity while safeguarding the environment for future generations.

Literature review. The issues of climate change and the transition to a green economy have become central themes in modern economic research. A broad body of literature emphasizes that environmental degradation and economic growth are deeply interconnected, and that long-term macroeconomic stability cannot be achieved without integrating ecological limits into development strategies.

Early studies on economic growth largely focused on capital accumulation, labor productivity, and technological progress, with limited attention to environmental externalities. Traditional macroeconomic models, particularly neoclassical frameworks, treated natural resources as abundant or substitutable, thereby underestimating the long-term economic consequences of climate change. However, as environmental crises intensified, economists increasingly recognized the need to revise these assumptions. This led to the emergence of environmental economics and later ecological economics, both of which challenged the conventional understanding of growth by emphasizing sustainability, resource scarcity, and intergenerational equity.

A significant contribution to the literature came from researchers who examined the economic costs of climate change and the urgency of policy intervention. These studies argued that climate change is not only an environmental issue but also a macroeconomic threat affecting output, employment, inflation, investment, and public finance. Climate-related shocks such as droughts, floods, heatwaves, and energy insecurity have been shown to reduce productivity and disrupt economic systems at both national and global levels. In this context, macroeconomic policy is increasingly viewed as a necessary instrument for climate adaptation and mitigation.

The concept of the green economy emerged as an alternative development paradigm aimed at reconciling economic growth with environmental sustainability. Scholars define the green economy as an economic system that improves human well-being and social equity while significantly reducing environmental risks and ecological scarcities. This approach highlights the importance of renewable energy, green finance, sustainable production, circular economy practices, and low-carbon technologies. Many researchers argue that the green economy is not a constraint on growth, but rather a source of new jobs, innovation, industrial modernization, and long-term competitiveness.

Within the macroeconomic literature, several approaches have been proposed to incorporate environmental dimensions into economic modeling. One approach is the use of green growth models, which focus on maintaining GDP growth while reducing carbon emissions and improving resource efficiency. These models often stress the role of technological progress, cleaner energy systems, and environmental regulation. Another strand of literature focuses on post-growth or degrowth perspectives, which criticize the overreliance on continuous expansion and argue for a reorientation of economic priorities toward social welfare, ecological balance, and sufficiency. Although these perspectives differ in their assumptions, both contribute to the broader debate on how macroeconomic systems should respond to climate change.

A large number of studies also examine the role of green investment in sustainable macroeconomic transformation. Public and private investment in renewable energy, energy-efficient infrastructure, sustainable agriculture, green transport, and waste management is widely considered a key driver of the low-carbon transition. Researchers note that green investment has strong multiplier effects, stimulates employment, and enhances long-term productivity. At the same time, the literature points out that effective green investment requires institutional support, access to finance, technological capacity, and coherent policy frameworks.

Another important theme in the literature is carbon pricing and environmental taxation. Many economists suggest that carbon taxes and emissions trading systems are effective tools for internalizing negative environmental externalities. By assigning a cost to pollution, these instruments encourage firms and households to shift toward cleaner production and consumption patterns. Nevertheless, scholars also warn that carbon pricing mechanisms must be carefully designed to avoid regressive social impacts and competitiveness losses, especially in developing economies. Therefore, supportive fiscal and social policies are often recommended alongside environmental taxation.

The literature further highlights the growing relevance of green fiscal policy and sustainable monetary policy. Fiscal tools such as green subsidies, tax incentives, climate-responsive budgeting, and public expenditure on adaptation projects are seen as essential for accelerating ecological transition. In recent years, some researchers have also explored the role of central banks and financial institutions in supporting climate goals through green bonds, climate risk assessments, and sustainable lending practices. This has expanded the macroeconomic debate beyond production and consumption to include the financial architecture of sustainability.

In developing and transition economies, the literature often emphasizes that the green transition faces structural constraints, including limited financial resources, weak institutional capacity, dependence on fossil fuels, and technological gaps. Yet many studies also show that such economies can benefit significantly from green transformation through improved energy security, reduced environmental damage, and greater resilience to climate risks. Therefore, macroeconomic models for sustainability should be flexible enough to reflect country-specific conditions and development priorities.

Overall, the reviewed literature demonstrates a clear shift from conventional growth-centered macroeconomic thinking toward more integrated and sustainability-oriented approaches. However, despite considerable progress, there remains a gap in designing comprehensive macroeconomic models that systematically combine environmental protection, economic efficiency, and social inclusion. This research addresses that gap by proposing a sustainable macroeconomic model that reflects the realities of climate change and the principles of the green economy.

Research methodology. This study employs a mixed-method research approach combining qualitative and quantitative methods to develop a comprehensive and sustainable macroeconomic model in the context of climate change and the green economy. The methodology is designed to ensure both theoretical depth and empirical relevance, allowing for a systematic analysis of the interaction between economic growth and environmental sustainability.

Analysis and results. This section presents the empirical and conceptual findings derived from the application of the proposed sustainable macroeconomic model. The analysis focuses on examining the relationships between economic growth, environmental sustainability, and green investment, as well as evaluating the outcomes of integrating green economy principles into macroeconomic systems.

The analysis reveals that traditional economic growth patterns are strongly associated with increased carbon emissions and environmental degradation. Empirical observations indicate that,

in the absence of environmental regulation, GDP growth tends to lead to higher energy consumption and resource depletion. This reflects a positive correlation between economic output and emissions in conventional models.

However, the introduction of green economy components—particularly renewable energy and energy efficiency—alters this relationship. The results show that it is possible to achieve relative decoupling, where economic growth continues while the rate of environmental degradation slows. In more advanced scenarios, absolute decoupling can be observed, where emissions decline despite economic expansion.

The findings demonstrate that green investment plays a crucial role in enhancing both economic and environmental outcomes. Increased investment in renewable energy, sustainable infrastructure, and clean technologies contributes to:

- Higher employment levels in green sectors;
- Improved energy efficiency and reduced production costs over time;
- Increased innovation and technological advancement;
- Long-term economic resilience.

Quantitative analysis suggests that green investment has a positive multiplier effect on GDP, often exceeding that of traditional investments due to its spillover benefits in innovation and sustainability.

The study evaluates the role of carbon pricing mechanisms, including carbon taxes and emissions trading systems. The results indicate that:

- Carbon pricing effectively reduces emissions by incentivizing cleaner production and consumption patterns;
- Firms respond to environmental taxation by adopting energy-efficient technologies;
- Government revenues from carbon taxes can be reinvested into green projects, amplifying sustainability outcomes.

At the same time, the analysis highlights the importance of **policy design**. Without compensatory measures, carbon pricing may increase production costs and affect low-income households. Therefore, combining environmental taxes with social support policies ensures a more balanced and inclusive transition.

Table 1

Scenario analysis of the proposed model

Scenario	Description	Economic Outcome	Environmental Outcome
Baseline	Traditional growth model	Moderate GDP growth	High emissions
Green Transition	Moderate green policies	Stable GDP growth	Reduced emissions
Sustainable Model	Strong green policies and investments	High-quality growth	Significant emission reduction

The results indicate that the sustainable model scenario provides the most balanced outcomes, ensuring economic growth while achieving substantial environmental improvements.

Overall, the analysis confirms that the transition to a green economy is not only environmentally necessary but also economically beneficial. The proposed sustainable macroeconomic model demonstrates that it is possible to reconcile economic growth with environmental sustainability through well-designed policies, strategic investments, and institutional support.

Conclusion and suggestions. This study examined the growing challenges of climate change and the necessity of transitioning toward a green economy through the development of a sustainable macroeconomic model. The findings confirm that traditional economic growth models, which largely ignore environmental constraints, are no longer viable in the context of increasing ecological risks and resource limitations.

The research demonstrates that integrating environmental factors—such as carbon emissions, energy consumption, and natural resource use—into macroeconomic frameworks significantly improves the long-term sustainability and resilience of economic systems. The proposed model highlights the importance of aligning economic growth with ecological balance by incorporating green investment, renewable energy, and effective environmental policies.

The results further show that the transition to a green economy can generate multiple benefits, including enhanced economic efficiency, job creation, technological innovation, and reduced environmental degradation. Importantly, the study confirms that sustainable development is achievable when economic, environmental, and social objectives are addressed simultaneously within a unified macroeconomic framework.

At the same time, the research acknowledges that the transition process involves structural changes and policy challenges, particularly in developing economies. Therefore, a well-coordinated approach involving government institutions, private sector participation, and international cooperation is essential to ensure a smooth and inclusive transition.

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