Chapter 5

Is Green Growth Possible? The Intersection of Sustainable Development and Economic Performance

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Abstract

This chapter examines the concept of green growth by integrating theoretical perspectives, policy instruments, and empirical evidence, with a focus on the complex interplay between environmental sustainability and economic performance. Green growth posits that economic development can be decoupled from environmental degradation through targeted policy interventions and technological innovation. The first section revisits classical and modern economic growth theories, evaluating how green growth is supported or challenged within these frameworks. Key theoretical approaches such as decoupling theory, ecological modernization, the Porter hypothesis, and innovation-driven transitions are critically assessed. The chapter also discusses major critiques of green growth, including the physical limitations of absolute decoupling, rebound effects from efficiency gains, and concerns about equity and structural inequality embedded in the green capitalism paradigm. The second section focuses on carbon pricing mechanisms—carbon taxes and emissions trading systems—as well as green fiscal policies including public investments, subsidies, and tax reforms. Evidence from multiple case studies suggests that these instruments can effectively reduce emissions while supporting economic performance when designed and implemented coherently. Issues such as revenue recycling, sectoral targeting, and institutional capacity are emphasized as key success factors. The third section synthesizes empirical evidence from both developed and developing countries. Studies highlight the importance of political stability, policy consistency, and social protection mechanisms in mitigating potential negative impacts on growth and distribution. The chapter concludes that

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while green growth is not universally attainable under all conditions, it remains a viable and necessary development strategy when pursued through integrated, context-sensitive, and socially inclusive policies.

Introduction

Global climate change has emerged as one of the most significant environmental, economic, and social challenges in the pursuit of sustainable development goals. The urgency of crafting effective climate policies has necessitated a redefinition of the relationship between economic development and environmental protection. In this context, the concept of *"green growth"* has gained prominence in recent years, offering a paradigm that posits the simultaneous realization of economic growth and environmental sustainability. Green growth not only advocates a shift toward environmentally friendly technologies but also aims to create new employment opportunities, enhance resource efficiency, and strengthen social welfare. However, the practical feasibility of this concept—particularly its short- and long-term impacts on economic growth—remains a subject of ongoing debate in both academic and policy circles.

At the heart of green growth strategies lie economic instruments designed to reduce carbon emissions, foremost among them carbon pricing mechanisms. Carbon pricing represents a market-based intervention intended to internalize the negative externalities of greenhouse gas emissions. It is typically implemented either through direct carbon taxes or emissions trading systems (ETS). In both cases, the primary objective is to raise the economic cost of carbon emissions, thereby making environmentally friendly investments more attractive. Through this mechanism, increased energy and resource efficiency, accelerated adoption of clean technologies, and a reduction in overall carbon intensity are expected. Nevertheless, the real-world effects of carbon pricing are complex and vary significantly across countries, sectors, and income groups.

Recent empirical studies suggest that carbon pricing may exert short-term pressure on production and consumption by increasing energy prices, potentially slowing down economic growth in the immediate term. For instance, analyses of the EU ETS have indicated that rising carbon prices can temporarily suppress industrial output, while contributing to long-term emissions reductions and boosting green innovation. Känzig (2023) shows that policy shocks within the European carbon market have induced short-term recessionary effects, with varying impacts across income groups. Low-income households tend to be disproportionately affected due to their greater sensitivity to income losses and higher energy intensity in consumption. This

highlights the importance of integrating social considerations into the design of green growth policies. Nonetheless, the argument that carbon pricing inevitably hampers growth does not invalidate the green growth perspective altogether. Some studies contend that carbon pricing can enhance economic efficiency and stimulate long-term growth by incentivizing a reallocation of resources toward cleaner technologies. Alloisio and Galeotti (2022), in the context of the European Green Deal, argue that carbon pricing not only reduces emissions but also fosters green investment and drives capital reallocation. Moreover, policymakers can mitigate the potential adverse effects on growth by combining carbon pricing with tax shifts, subsidies, and social transfers. In doing so, the green transition becomes more equitable, balanced, and politically viable.

The situation is more complex in developing countries. A comparative study by Dossa and Miassi (2024) demonstrates that the effectiveness of carbon pricing policies in economies such as Argentina, Indonesia, and South Africa is highly contingent upon political stability, infrastructure quality, and institutional capacity. In many of these countries, fiscal constraints and entrenched fossil fuel subsidies limit the scope of carbon pricing, creating tensions between environmental objectives and economic development. By contrast, in countries with well-designed environmental fiscal frameworks, carbon taxes have been shown to reduce emissions without impeding economic growth (Mehta & Derbeneva, 2023). These findings suggest that the viability of green growth depends not only on the existence of specific policy instruments but also on their design, integration, and social equity dimensions. Taken together, the evidence indicates that green growth is neither universally feasible nor inherently contradictory. Its success depends on factors such as economic structure, policy coherence, income distribution, social support mechanisms, and innovation ecosystems. Therefore, green growth should be viewed not solely as an environmental objective but as a multidimensional development strategy. For both developed and developing countries, green growth holds the potential not only to reduce emissions but also to unlock new pathways for economic progress, employment, and social cohesion.

The primary aim of this chapter is to analyze the concept of green growth from both theoretical and empirical perspectives, and to examine the economic impacts of carbon pricing and green fiscal policies through an interdisciplinary lens. The second section explores the historical evolution and theoretical underpinnings of green growth, as well as its relationship with macroeconomic growth theories. The third section discusses how carbon pricing and green fiscal instruments affect growth in both theory

and practice. The fourth section presents a comparative empirical analysis of green growth experiences in developed and developing countries, highlighting the conditions under which it becomes feasible. The fifth section addresses challenges in policy design, implementation discrepancies, and social implications. The final section concludes with a synthesis of findings and offers policy recommendations regarding the applicability of green growth.

1. Green Growth and Theoretical Background

1.1 Definition and Scope of Green Growth

The concept of *"green growth"* has gained increasing prominence over the past decade in global policy documents, development strategies, and academic literature. However, despite its widespread use, the term remains contested in terms of its precise definition. At its core, green growth refers to a development strategy aimed at harmonizing economic growth with environmental sustainability. This approach seeks to minimize the environmental costs of growth by promoting more efficient use of natural resources, reducing greenhouse gas emissions, preserving ecosystems, and fostering the development of environmentally friendly technologies (Hallegatte et al., 2011).

Traditional growth models often externalize the environmental degradation that accompanies resource use and energy consumption. In contrast, green growth frameworks propose the internalization of these externalities and advocate for the integration of *"natural capital"* (e.g., forests, clean air, biodiversity) as a fundamental component of the production process (Pandey & Kaur, 2014). This perspective challenges the notion that economic development and environmental protection are mutually exclusive, suggesting instead that the two can reinforce each other through appropriate policy design (Toman, 2012). Leading global institutions such as the World Bank, the OECD, and the United Nations Environment Programme (UNEP) define green growth as a model of low-carbon, resource-efficient, and environmentally sustainable development. According to the OECD (2011), green growth is *"a framework for fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies."* This framework rests on the premise that environmental regulations can enhance economic efficiency and create new green sectors.

Hallegatte (2012) conceptualizes green growth not merely as a damage-limiting strategy, but as a transformative approach that renders growth

processes *"cleaner, more resilient, and more resource-efficient."* In this view, green growth involves a systematic restructuring of production and consumption patterns and necessitates addressing social inequalities. For instance, ensuring energy access for low-income households and implementing just transition policies are integral to a comprehensive green growth agenda.

Importantly, green growth is not limited to environmental protection but encompasses broader social and economic objectives. Toman (2012) emphasizes that green growth entails not only preserving natural capital to enhance social welfare but also reducing poverty and transforming labor markets. Thus, the concept expands from a simple environmental-economic nexus to a multidimensional strategy for social justice and economic inclusion. Stoknes and Rockström (2018) further broaden the scope of green growth by framing it within the concept of *"planetary boundaries."* They argue for a model of *"genuine green growth"* that not only focuses on emission reductions but also respects the ecological carrying capacities of natural systems. Within this broader framework, green growth must extend beyond energy efficiency to include agriculture, water, forestry, and biodiversity—encompassing all essential ecosystem services.

Despite its widespread appeal, some scholars criticize green growth for its conceptual vagueness and excessive flexibility. Livermore (2014) contends that the term has become *"something everyone can support, but no one can clearly define."* Hickel and Kallis (2019) add that the green growth narrative often rests on the unproven assumption that technological solutions alone can fully decouple economic growth from environmental harm—a claim not strongly supported by empirical evidence. These diverse definitions and frameworks indicate that green growth functions as a flexible umbrella concept. It integrates multiple goals including economic development, environmental protection, resource efficiency, social equity, and sustainable development. However, the success of this integration depends largely on the quality of policy design, the strength of political commitment, institutional capacity, and technological innovation. As such, defining green growth is not merely a conceptual exercise but a strategic choice that influences the prioritization of policies and the configuration of implementation tools.

1.2 The Relationship Between Classical-Modern Growth Theories and Green Growth

Throughout history, economic growth theories have primarily focused on productivity, capital accumulation, and labor as explanatory factors of societal prosperity. However, environmental sustainability has been

largely overlooked or treated as an external issue in most of these models—especially until the latter half of the 20th century. Green growth discourse offers a corrective perspective by directly addressing this omission, calling for a new theoretical integration that reconsiders how classical and modern growth models interact with environmental factors. While classical economics did not explicitly account for environmental constraints, such limits were at times acknowledged indirectly. For example, Adam Smith's growth model, grounded in division of labor and economies of scale, placed capital accumulation and market expansion at the center of long-term development, often treating nature as a *"free resource."* In contrast, Malthus's arguments concerning resource scarcity and population growth pointed more directly to environmental limits, though these ideas did not significantly influence later growth models (Sengupta & Hazra, 2015). Neoclassical growth models, particularly the Solow-Swan model, explain growth through capital accumulation, labor expansion, and technological progress, yet omit environmental inputs from the production function. In Solow's framework, output is defined as $Y = A \cdot f(K, L)$, where natural resources and environmental capital are assumed constant. Consequently, environmental degradation is excluded from the potential constraints to growth. This externalization of ecological variables stands in stark contrast to the central assumptions of green growth thinking (Smulders, Toman, & Withagen, 2014).

In more recent developments, endogenous growth theories offer greater flexibility by internalizing technological change, potentially addressing environmental challenges more effectively. Romer's (1990) knowledge-based growth model argues that innovation can sustain long-term growth, but pays little attention to the direction or environmental nature of such innovation. As a result, the development of green technologies is largely contingent upon active public policy intervention—reinforcing the green growth claim that innovation must be policy-driven (Jacobs, 2012). In these newer models, the concept of *"factor-augmenting technical change"* has gained importance. This approach emphasizes the need to steer technological progress toward reducing resource use and lowering emissions intensity. Smulders and colleagues (2014) highlight that such targeted technical change is essential for green growth, but caution that it cannot be expected to occur automatically; rather, it requires significant institutional and policy interventions.

Simultaneously, contemporary theoretical contributions have begun to reinterpret classical growth models through a green lens. For instance, so-called "*Green Solow Models"* show that a long-term growth equilibrium can

be achieved alongside declining emission intensity. These models explicitly incorporate carbon emissions and environmental degradation into the production process (Augeraud-Veron et al., 2024), making green growth not only a topic of policy discourse but also an analytical component of modern growth theory. Nonetheless, despite these theoretical adaptations, green growth remains only partially integrated into classical and modern growth frameworks. Industrial structures, the cost of transforming energy-intensive sectors, and the diffusion rate of environmental technologies introduce real-world constraints that often diverge from the assumptions of theoretical models. Hickel and Kallis (2019) argue that green growth must be subjected not only to model-based optimism but also to rigorous empirical testing, along with open debate about alternative growth pathways. In conclusion, while classical and modern growth theories may fall short in directly explaining green growth, their revision and extension provide a stronger basis for modeling the interactions between the environment and the economy. Incorporating green growth into the broader economic growth literature requires not only theoretical innovation but also a redefinition of the boundaries and objectives of growth itself.

1.3 Theoretical Arguments Supporting Green Growth

Green growth is not merely a policy preference aimed at reconciling economic and environmental objectives; it also represents a theoretical claim that economic growth can be sustained under a new paradigm. Several frameworks have been developed to support this perspective, including decoupling theory, ecological modernization theory, the Porter hypothesis, the environmental Kuznets curve, and innovation-driven transformation models. Collectively, these frameworks suggest that economic growth and environmental degradation are not inherently in conflict and that, under the right conditions, environmental sustainability can enhance growth.

Decoupling Theory is a foundational premise of green growth, positing that economic expansion can be *"decoupled"* from environmental harm. Relative decoupling refers to a decline in environmental pressure per unit of GDP, whereas absolute decoupling requires that environmental indicators (e.g., CO_2 emissions) decline in absolute terms despite economic growth. Institutions such as the OECD, UNEP, and the World Bank emphasize the realization of decoupling as a key condition for green growth success (Stoknes & Rockström, 2018). However, this framework faces significant criticism. Hickel and Kallis (2019) argue that no major economy has yet achieved sustained, absolute decoupling, rendering green growth more of a technological aspiration than a grounded policy model. Antal and van den

Bergh (2016) similarly question whether decoupling can occur at the pace necessary to meet global climate targets. Thus, while decoupling may be a necessary condition for green growth, it is certainly not a sufficient one.

Ecological Modernization Theory (EMT) presents another prominent foundation for green growth. EMT posits that environmental problems can be resolved through market mechanisms, green technologies, regulatory frameworks, and institutional innovation. Far from being a constraint, environmental protection is seen as a driver of modernization and economic opportunity (Vazquez-Brust & Sarkis, 2012). The theory highlights the role of private sector innovation and the transformative capacity of environmental policy in production processes. Empirical evidence from Northern European countries shows success in sectors such as energy efficiency, waste management, and eco-industrial development (Thombs & Huang, 2019). Still, critics argue that EMT overlooks global inequalities, the externalization of environmental costs, and the absence of political will in many regions (Schmidlehner, 2023).

The Porter Hypothesis is one of the most empirically tested theories supporting green growth. Proposed by Michael Porter, it argues that well-designed environmental regulations can stimulate innovation, thereby improving productivity and long-term competitiveness. According to this view, environmental policy is not a cost but an investment with dynamic returns. Empirical studies on OECD countries support the *"weak"* version of the hypothesis, showing that environmental regulation has a positive effect on green productivity up to a certain threshold (Wang, Sun, & Guo, 2019). However, if regulatory stringency exceeds that threshold, the costs may outweigh the innovation benefits—suggesting the need for nuanced, sector-specific analyses.

The Environmental Kuznets Curve (EKC) is also cited in green growth literature. EKC posits that environmental degradation initially increases with economic growth but begins to decline after a certain income level, as societies invest in cleaner technologies and adopt stronger environmental norms and policies. While the EKC has been empirically validated for certain pollutants such as sulfur dioxide, it holds less explanatory power for global carbon emissions and climate change. Recent studies suggest that emissions continue to rise with economic expansion, contradicting the EKC model (Antal & van den Bergh, 2016; Hickel & Kallis, 2019). Thus, while the EKC may offer limited support for green growth, it is insufficient for meeting absolute emission reduction goals. Technology-Oriented and Systemic Transformation Theories go further, advocating not only for

reform within existing economic structures but also for more fundamental, systemic change. The ecological macroeconomics approach, for example, proposes new models of growth that incorporate resource constraints and ecological limits (Jackson, Victor, & Naqvi, 2016). These models account not only for production and consumption, but also for financial stability, income distribution, and the environmental impacts of public spending. While aiming to enable growth, these frameworks also strive to reduce dependency on it—redefining development in terms of qualitative rather than quantitative expansion.

The theoretical frameworks that support green growth suggest that technological innovation, sound regulation, and market incentives can create a balance between economic development and environmental sustainability. However, each of these frameworks rests on specific assumptions and faces important limitations. For this reason, green growth must be understood not only as a technical challenge but also as a political and ethical project. While theory can illustrate its plausibility, the real determinants of success will depend on the nature and quality of practical implementation.

1.4 Critiques of Green Growth

While green growth is often presented as a promising strategy to align environmental sustainability with economic expansion, its realism and feasibility have been the subject of growing scrutiny. Critiques of green growth generally converge around three main axes: (1) the physical and structural limitations of absolute decoupling between economic growth and environmental impacts, (2) the unintended rebound effects stemming from overreliance on technological solutions, and (3) the neglect of global inequalities and structural power relations embedded in green capitalism.

- *The Limits of Absolute Decoupling*

A key assumption underlying green growth is that economic expansion can be decoupled from environmental degradation. However, critics argue that absolute decoupling—i.e., the sustained reduction of total environmental pressures alongside continued economic growth—is unlikely to occur under current scientific and technological constraints. Hickel and Kallis (2019) emphasize that, based on existing emissions data and resource consumption trends, no major economy has achieved absolute decoupling in a manner consistent with green growth goals. In fact, in many high-income countries, reductions in energy and material intensity are offset by increased production volumes, resulting in continued environmental pressures.

Pueyo (2019) draws attention to the thermodynamic limits of decoupling, reminding us that energy and material flows are constrained by physical laws. This perspective suggests that the green growth narrative often ignores the fundamental contradiction between biophysical limits and economic structures. Similarly, Mauerhofer (2013), in his analysis of the European Union, finds that improvements in environmental indicators have largely been achieved through the externalization of pollution—namely, by relocating polluting production activities abroad.

- *Rebound Effects and Overreliance on Technology*

Although green growth strategies frequently center on efficiency-based technological solutions, one of the most prominent criticisms relates to rebound effects. Rebound effects occur when efficiency improvements lead to lower costs, which in turn stimulate higher consumption—thereby negating environmental gains. Nørgård and Xue (2016) demonstrate that, within growth-oriented economic systems, efficiency-driven green growth strategies often fail to deliver net emission reductions due to significant rebound effects. Pueyo (2019) further argues that the constant acceleration of innovation systems not only undermines environmental goals but also threatens social and institutional sustainability. From this perspective, a purely technology-focused green growth paradigm is seen as addressing the symptoms rather than the root causes of ecological crises.

- *Structural Inequality and Critiques of Green Capitalism*

Another line of critique targets green growth's neglect of structural inequalities and its continued reliance on capitalist growth paradigms. Krähmer (2020), for example, demonstrates how Copenhagen—despite its label as *"Europe's Green Capital"*—fails to account for emissions embedded in outsourced production, with many sustainability policies aimed more at enhancing competitiveness than achieving genuine ecological transformation. Such findings lend support to critiques that characterize green growth as a form of *"greenwashing."*

Proponents of the degrowth movement offer a more radical critique, calling for systemic transformation beyond growth. Sandberg, Klockars, and Wilén (2019) argue that green growth often reproduces environmental pressures on the Global South and is fundamentally incompatible with genuine sustainability. According to this perspective, sustainability can only be achieved through the downscaling of production and consumption. Katz-Rosene and Ambe-Uva (2023) likewise contend that current global environmental regimes are still anchored in the green growth paradigm,

while a *"post-growth"* approach is needed for deeper systemic change. As green growth attempts to reconcile sustainability with development, its critics increasingly point to its technological limitations, structural blind spots, and political inadequacies. The constrained feasibility of absolute decoupling, the prevalence of rebound effects, and the persistence of global power asymmetries all suggest that green growth alone may be insufficient to achieve sustainable development. Accordingly, a growing body of scholars and activists are calling for more equitable, low-consumption, and socially transformative alternatives. These critiques do not necessarily reject green growth outright but rather urge a clear recognition of its boundaries—and, where appropriate, a planned transition toward *"green post-growth"* strategies.

2. Policy Instruments and Green Growth

2.1 Carbon Pricing: Carbon Taxes and Emissions Trading Systems

Carbon pricing is one of the most fundamental market-based instruments designed to internalize environmental externalities. By assigning a cost to carbon emissions, it aims to shift the behavior of both firms and consumers toward more environmentally sustainable choices. There are two primary mechanisms for carbon pricing: carbon taxes and emissions trading systems (ETS). Although both seek to reduce emissions, they differ significantly in terms of implementation design, impact on economic growth, and political acceptability.

- *Carbon Taxes: A Price-Based Approach*

A carbon tax sets a fixed price per ton of carbon dioxide emitted, providing a clear and predictable signal to emitters. One of its primary advantages is price stability, which facilitates long-term investment planning by firms. However, because the emission quantity is not capped, environmental outcomes remain uncertain. Xiong (2024) finds that while carbon taxes may induce short-term slowdowns in developing economies, they tend to promote sustainable growth in the long term through green investment and efficiency gains. Revenue recycling mechanisms—such as tax swaps or direct transfers—play a crucial role in increasing public acceptance and offsetting regressive effects. British Columbia's carbon tax has been shown to reduce emissions without hindering economic growth. Haites (2018) also notes that many carbon tax schemes in Europe after 2008 have contributed to emission reductions, though their success often depends on complementary climate policies.

- *Emissions Trading Systems (ETS): A Quantity-Based Approach*

ETS mechanisms impose a cap on total emissions and allocate allowances to firms, which can be traded in the market. Their key advantage is environmental certainty through an absolute emissions ceiling. However, permit prices are subject to market fluctuations, introducing volatility and potential uncertainty for investors. Yang (2023) highlights that China's ETS offers greater market flexibility than a carbon tax but may induce price volatility, which complicates investment decisions. Jia, Wen, and Wu (2025) show that combining ETS with carbon taxes creates a synergistic effect, reducing emissions by an additional 6% in targeted sectors. The European Union ETS is the most established example of a large-scale cap-and-trade system. However, an oversupply of allowances in its early years led to low carbon prices and diminished effectiveness. Flues and van Dender (2020) stress the need for price stabilization mechanisms, such as price floors, to ensure investment signals are strong and reliable.

- *Impacts of Carbon Pricing on Economic Growth*

The economic effects of carbon pricing depend on a country's industrial structure, policy design, and accompanying social safety nets. Ahmad, Li, and Wu (2024) conduct a meta-analysis of 81 empirical studies, concluding that both carbon taxes and ETS are effective in reducing emissions, with carbon taxes showing slightly stronger effects. However, these instruments can also produce unequal economic impacts. Zhang et al. (2023) report that lower-income urban households in China suffer greater income losses under carbon pricing, underlining the importance of redistributive mechanisms to ensure social equity. Contrary to the idea that carbon taxes and ETS are substitutes, an emerging body of research advocates for their complementary use. When implemented in parallel—targeting different sectors or emissions sources—these instruments broaden the policy scope and improve cost-effectiveness (Ahmad, Li, & Wu, 2024). This dual strategy is particularly useful for managing transition costs and minimizing adverse growth impacts. In summary, carbon pricing—when carefully designed and politically supported—can reduce emissions while minimizing disruptions to economic growth. Combining carbon taxes with cap-and-trade systems and recycling revenues into social programs or green investments enhances both the environmental and social outcomes of climate policy.

2.2 Green Fiscal Policies

Green fiscal policies encompass a range of government interventions—including public spending and tax reforms—designed to integrate

environmental sustainability with economic growth. These include investments in green infrastructure, subsidies for renewable energy, environmental tax incentives, and the restructuring of public budgets. The overarching goal is to promote environmentally friendly production and consumption while enhancing resource efficiency and stimulating employment and growth.

Dafermos and Nikolaidi (2019) categorize green fiscal policies into three key components: carbon taxes, green public investment, and green subsidies. While each component can yield specific environmental benefits in isolation, coordinated and comprehensive policy mixes tend to produce stronger results. For example, public investment in clean energy, transportation, and building efficiency can stimulate short-term economic activity while achieving long-term reductions in carbon emissions. Empirical studies support these claims. Sun et al. (2024), in their analysis of BRICS nations, show that green fiscal instruments increase both resource efficiency and renewable energy investment. Moreover, their impact on growth is more balanced compared to traditional stimulus tools. However, the effectiveness of these policies hinges on proper targeting and the presence of monitoring systems that prevent waste. Subsidies, in particular, are a double-edged sword. Makhfudhah and Rasyid (2025) find that subsidies in renewable energy and low-carbon technologies accelerate investment, but also suffer from implementation inefficiencies and inequality across sectors. Wang and Yan (2024), using a DSGE model for China, argue that compared to environmental taxes, green subsidies more effectively reduce emissions and enhance welfare. Their findings suggest that subsidies not only encourage innovation and R&D but also support transformation in industrial capacity (Yan & Wang, 2024). Still, they caution that allocating public funds solely to environmental remediation may diminish firms' incentives to reduce emissions themselves. Moreover, Dafermos and Nikolaidi emphasize the interaction between green fiscal tools and the financial system. Carbon taxes, for instance, may lower firm profitability, heightening credit risk and potentially limiting access to green finance. Thus, green tax policies should be coordinated with financial regulations to maintain economic stability.

European green budgeting practices have introduced institutional tools to evaluate the alignment of public expenditures with climate goals. Ljubičić (2025) underscores the importance of anchoring green fiscal reforms in a robust legal and institutional framework to ensure long-term policy consistency. Tax incentives can also address regional and sectoral inequalities. Shi and Ge (2025) reveal that while tax credits and subsidies boosted green innovation in China's new energy vehicle sector, regional

disparities influenced the overall policy effectiveness. This highlights the need for context-sensitive policy design rather than one-size-fits-all approaches. Jones (2011) similarly emphasizes that eliminating environmentally harmful subsidies and redirecting public spending toward green sectors can enhance both environmental and economic performance—but social acceptance depends heavily on accompanying welfare policies. In sum, green fiscal policies require the restructuring of public budgets to simultaneously support emissions reduction, accelerate structural transformation, and reduce inequalities. Their success depends not only on economic design but also on institutional capacity, transparency, and social cohesion mechanisms.

2.3 Just Transition Policies

The social impacts of green transformation processes are gaining increasing attention, alongside their economic and environmental effects. The *"just transition"* approach offers a framework aiming to design climate policies without overlooking social justice. According to this approach, specific social, employment, and income policies are essential to prevent workers in carbon-intensive sectors, low-income groups, and vulnerable communities from being adversely affected by the transition process. A just transition is not merely a tool for social mitigation; it is a critical component that ensures the political legitimacy and long-term success of green growth.

Hirvilammi and Ding (2024) identify three core pillars of a just transition: green jobs, green skills, and green compensation. This structure encompasses three main levels of social security: employment creation, skills transformation, and income security. The simultaneous and balanced implementation of these three elements ensures that labor markets become socially resilient to the green transformation. The short-term effects of climate policies, such as carbon pricing, can impose disproportionate burdens, particularly on low-income groups. Zhang et al. (2023) reveal that carbon pricing in China has had more severe impacts on low-income urban households, significantly increasing the share of energy expenditures in their total consumption. Therefore, it is proposed that revenues generated from carbon pricing be converted into social transfers through revenue recycling. Practices such as the *"climate bonus"* and *"green energy voucher"* implemented in Europe have been developed for this purpose. Gough (2015) argues that green growth policies can only be just when implemented alongside radical interventions in production and consumption models. According to him, merely creating new job opportunities is insufficient; more structural interventions are also required, such as reducing working hours,

strengthening social security systems, and transforming lifestyles based on high carbon consumption.

Although the increase in green collar jobs is often presented as an indicator of a successful just transition, the nature, security, and inclusivity of such employment must also be considered. Masterman-Smith (2010) demonstrates that green jobs can evolve into precarious, low-wage, and non-unionized employment, particularly for low-skilled workers. Consequently, a just transition should not only encompass job creation but also the right to work under decent and fair conditions. Dimitris Stevis and Felli (2015) note that global trade unions have played a significant role in shaping the just transition approach; however, this framework still struggles to fully internalize class, racial, and regional inequalities. Particularly in the Global South, criticisms are raised that green transformation processes proceed as external impositions, with local populations not being meaningfully included in the process.

Luo, Li, and Feng (2024) found that the implementation of a carbon market in China reduced the labor income share of firms while simultaneously increasing overall labor productivity. This finding indicates that low-wage workers have not sufficiently benefited from productivity gains, thereby exacerbating income inequality. This highlights that a just transition necessitates support not only from sectoral transformation but also from income distribution and job security policies. D'Alessandro et al. (2020) demonstrate that both environmental and social objectives are more effectively realized in scenarios where green growth policies are integrated with social equality policies. In such scenarios, directing public expenditures towards social security, employment guarantee, and reskilling programs has been observed to reduce inequalities, decrease unemployment, and significantly cut carbon emissions. Bohnenberger (2022) advocates for the integration of employment policies with green transformation, stating that the redistribution of working hours, vocational transition guidance, social wage implementations, and climate-supported job guarantee models are effective tools for a just transition. Within this framework, it is evident that there is a need for not only market-based instruments but also strong public interventions. In conclusion, just transition policies emerge as a key element in ensuring the societal acceptance of green growth. These policies aim to fairly distribute the costs of environmental objectives and to reduce, rather than exacerbate, inequalities during transformation processes. It is essential to not only create jobs but also to provide decent, secure, fairly paid, and inclusive employment opportunities, while also considering factors such as energy poverty, social protection, and regional justice. A just transition is

not merely a policy choice but a strategic imperative that centers the social dimension of sustainable development.

2.4 Policy Mix and Harmonious Design

The successful realization of green growth hinges not merely on the efficacy of individual policy instruments but also on how these instruments interact with one another. A multitude of policy tools—such as carbon pricing, green subsidies, social transfers, green public expenditures, and regulatory measures—can only achieve both environmental and economic objectives when integrated within a well-designed policy mix. Policy coherence necessitates considering inter-sectoral externalities and structuring instruments in a complementary manner regarding timing, intensity, and scope.

Skjærseth (2021) notes that climate and energy policies developed under the European Green Deal were initially implemented in a fragmented and sectoral manner. However, they gradually evolved into a more coordinated and systemic policy mix. This transformation was achieved by supplementing market-based instruments like carbon pricing with subsidies and social policy tools. For instance, the EU Emission Trading System (ETS) has been integrated with the Innovation Fund, established for low-carbon investments, thereby enhancing the impact of price signals on investment behavior. Yin et al. (2020) contend that in green growth strategies, tax and subsidy policies should be viewed as complementary rather than substitutable instruments. They highlight that subsidies are more effective in directing consumer behavior towards green products, while carbon taxes are more effective on the producer side. Similarly, Tu and Mo (2017), using the Chinese context, demonstrate that the combined implementation of carbon pricing and renewable energy subsidies prevents the destabilization of CO2 prices and leads to more effective overall emission reductions.

Hoarau and Meunier (2023) emphasize the importance of considering life cycle emissions in policy mix analyses. For example, the true impact of subsidies for electric vehicles can vary depending on the source of electricity generation. Therefore, integrated policy packages that intervene across the entire production chain, not just the final product, should be designed. Furthermore, implementing simultaneous incentives in both upstream and downstream sectors can mitigate undesirable effects such as emission leakage. Sonnenschein (2019) states that many countries fail to achieve their climate targets with individual policies, often due to contradictions between instruments, timing mismatches, and insufficient behavioral analyses. In

designing policy instruments, their potential for behavioral response and political acceptance should be considered, alongside technical effectiveness. For example, carbon taxes might elicit stronger consumer resistance, but combining these taxes with revenue recycling can increase their acceptance rate. Examining the case of South Africa, Suphachalasai et al. (2023) show that climate targets can only be achieved when carbon pricing is implemented alongside subsidy reforms and social protection programs. Similarly, Jiang et al. (2024), in their modeling study on the Chinese energy sector, indicate that individual policies lead to both economic losses and limited emission reductions. In contrast, policy mixes (carbon tax + subsidy + green certificates) yield more balanced outcomes. Finally, Veugelers (2014) emphasizes that for green innovation policies to be effective, the policy mix should not be limited to internal coordination but also include international alignment and coordination. It is noted that international differences in carbon prices can distort competition among firms, thus necessitating the inclusion of complementary external trade instruments, such as a carbon border adjustment mechanism, in the policy mix. In conclusion, to achieve green growth objectives, the question should not only be *"which instrument?"* but also *"how should these instruments work together?"* A well-designed policy mix can strengthen the environmental, economic, and social foundations of the green transformation by combining the price signal of carbon pricing, the investment incentives of subsidies, and the justice dimension of social policies. This approach not only reduces emissions but also enhances societal legitimacy and economic resilience.

3. Empirical Evidence from Country Experiences

3.1 Experiences in Developed Countries: EU, Sweden, South Korea, Canada

Developed countries have emerged as pioneering testing grounds for the environmental and economic impacts of green growth strategies. These nations have experimented with diverse policy mixes, including carbon taxes, emission trading systems (ETS), green public expenditures, environmental tax reforms (ETR), and subsidies. The success of these policies has largely been shaped by institutional capacity, public support, and political commitment.

The EU became a global pioneer in carbon pricing with the launch of its Emission Trading System (EU ETS) in 2005. The system covers approximately 11,500 installations across over 30 countries, regulating up to 40% of EU emissions. However, the initial phase saw limited emission

reduction due to persistently low prices. Subsequent reforms have increased carbon prices, making the system more effective (Skjærseth, 2021). The EU also supports countries implementing carbon taxes and advocates for environmental tax reforms. Cottrell and Meyer (2012) demonstrate that ETR implementations have contributed to emission reductions and positively impacted employment by shifting the tax burden from labor to environmental expenditures. Nevertheless, the widespread adoption of ETR has raised concerns about increased costs in certain sectors (Cottrell & Meyer, 2012).

Sweden has maintained one of the world's highest carbon taxes since 1991 (approximately €130/ton as of 2024). This policy has led to significant emission reductions, with per capita emissions decreasing by 27% compared to 1990 (Sterner, 2020). During this period, the Swedish economy continued to grow, unemployment rates did not increase, and investments in energy efficiency and renewable energy surged (Runst & Thonipara, 2019). Furthermore, carbon pricing has been integrated with a broader set of policies, including electric vehicle subsidies and incentives for energy efficiency in buildings. Broad public support, high institutional capacity, and early policy actions have played crucial roles in Sweden's success. However, Lundgren et al. (2015) indicate that in some sectors (e.g., pulp and paper industry), carbon prices have been insufficient for technological transformation, and fossil fuel prices could be more decisive.

South Korea adopted a *"Low Carbon, Green Growth"* strategy in 2008, aiming for a 30% emission reduction by 2020. The Korea Emissions Trading Scheme (KETS), established in 2015, has been implemented across the industrial, energy, and construction sectors (National Green Growth Strategy of South Korea, 2014). During this process, South Korea has supported growth through green infrastructure projects, R&D subsidies, and incentives for low-carbon industries. Mathews (2012) interprets this strategy as an industrial policy, crediting it with contributing to the emergence of new green export sectors (Mathews, 2012). However, Heo (2015) noted that the policy was initially shaped by strong industrial lobbies, resulting in insufficient social policy components. Criticisms have been raised regarding the need for greater participation from various segments of society and increased transparency.

In Canada, carbon pricing has been mandated at the federal level, though implementation varies by province. British Columbia, for instance, has applied a carbon tax since 2008, leading to both emission reductions and continued economic growth. However, in fossil fuel-intensive provinces like

Alberta, such policies have faced strong opposition (Kopytin et al., 2018). Nationwide, the impact of carbon pricing has been somewhat limited, with subsidies and public investments proving more effective in facilitating the transition to low-carbon technologies. Moreover, revenue recycling policies for carbon tax revenues have mitigated negative impacts on low-income groups.

3.2 Experiences in Developing Countries: China, India, South Africa, Brazil

Developing countries represent both the greatest potential and the most significant vulnerabilities regarding green growth strategies. Nations like China, India, South Africa, and Brazil are striving to balance their rapid growth imperatives with environmental sustainability goals. However, the green growth policies implemented in these countries are challenged by multifaceted issues such as institutional capacities, financial limitations, social inequalities, and external dependencies.

China, while being the world's largest carbon emitter, also possesses the largest green finance market. China's carbon trading system was elevated to a national level in 2021, initially limited to the power generation sector. While expansion of this system is planned, investments in renewable energy and low-carbon infrastructure have accelerated through green financing (Haryono, 2024). Nevertheless, inadequate oversight, regional disparities, and limited social impact analyses stand out as key weaknesses in China's green transition. Wang et al. (2022) demonstrate that economic complexity, renewable energy utilization, and environmental tax revenues have strong effects on green growth in China, but regional asymmetries limit policy effectiveness.

India is implementing its green growth strategy through public-private partnerships. The National Electricity Plan has seen significant increases in renewable energy investments, yet coal dependence still poses a substantial environmental risk (Satija, 2013). Chen et al. (2023) emphasize that environmentally focused patent applications in India boost green growth, but this effect is directly linked to the level of financial globalization. India's private sector plays a dynamic role in green investments; however, due to the depth of social inequalities, energy access and the regional distribution of green employment remain problematic.

South Africa became the first African country to implement a carbon tax in 2019. However, high unemployment and poverty rates make social acceptance of carbon pricing challenging. Awan et al. (2024) analyzed the

relationship between environmental policy stringency and green innovation in South Africa, finding that weak institutional capacity undermines this relationship. Nevertheless, when renewable energy investments and local employment policies are implemented together, they are observed to contribute to both emission reduction and growth objectives.

Brazil, despite its vast forest and biomass potential, has experienced significant setbacks in its environmental policies in recent years. The agricultural sector's impact on deforestation remains the biggest obstacle to green growth targets. Zaman et al. (2016) show that nuclear energy and renewable electricity generation in Brazil have a positive effect on growth, but agricultural carbon emissions negatively impact growth. Miranda et al. (2021) note that the use of green technology in Brazil is quite limited, and policy implementations often remain on paper.

A common characteristic among these countries is the imperative to shape their green growth objectives not only through environmental lenses but also through social, fiscal, and institutional dimensions. The success of green transformation policies in developing countries largely depends on external financial support, technology transfer, institutional capacity building, and social policy integration.

3.3 Comparative Assessment

The success of green growth strategies depends not only on the specific instruments implemented but also on country-specific characteristics, institutional structures, societal demands, and the international context. Significant differences exist between developed and developing nations in terms of implementation capacities, priorities, and the challenges they face. In this section, we provide a multi-dimensional comparison of green growth performance in developed countries such as the European Union, Sweden, Canada, and South Korea, alongside emerging economies like China, India, Brazil, and South Africa.

Developed countries generally possess higher institutional capacity, greater fiscal space, and stronger public support. Tools like carbon pricing, emission trading systems (ETS), green public investments, and environmental tax reforms can be effectively implemented in these nations. In countries such as Sweden, the carbon tax has successfully reduced emissions while maintaining economic growth (Sterner, 2020). The European Union, meanwhile, promotes structural transformation across sectors by integrating its ETS with incentive mechanisms like the Innovation Fund (Skjærseth, 2021).

Conversely, developing countries face more complex dynamics in their green growth endeavors. Fundamental development challenges, including rapid growth, energy security, poverty alleviation, and income inequalities, sometimes conflict with environmental sustainability goals. For instance, while China implemented carbon trading with the aim of increasing economic complexity and developing financial infrastructure, regional inequalities limit the system's effectiveness (Wang et al., 2022). Although South Africa introduced a carbon tax, the country's high unemployment and reliance on fossil fuels necessitate robust social support mechanisms (Awan et al., 2024). Kazemzadeh et al. (2025), in their study across 90 countries, highlight institutional quality, innovation capacity, and low vulnerability levels as key drivers of green growth. Particularly in developing countries, political instability and low state capacity often jeopardize the continuity of green policies (Kazemzadeh et al., 2025).

Furthermore, differences in economic structures are crucial. Developed nations typically exhibit lower energy intensity, have dominant service sectors, and find it easier to integrate renewable energy. In contrast, developing countries are characterized by more prominent energy-intensive industries and agricultural sectors. Habib et al. (2023) note that the green growth potential in the agricultural sector remains limited in less developed countries, compounded by low resource utilization efficiency. Finally, the interplay between public opinion and political will is also a determinant. Jacobs (2012) emphasizes that green growth is not merely a technical matter but also a political choice. In developed countries, greater public support for environmental issues facilitates the acceptance of long-term climate strategies. In developing countries, however, green growth policies often succumb to short-term development pressures. This comparative analysis demonstrates that there is no universal prescription for successful green growth. Policies must be designed flexibly and holistically, adapted to local conditions, institutional capacity, economic structure, and societal demands.

Conclusion and Policy Recommendations

This study analyzed both the theoretical foundations and practical applications of the green growth concept, comparatively examining the economic, environmental, and social outcomes of policy instruments adopted in different countries. In developed countries, implemented carbon taxes, emission trading systems, and green public investments have, under certain conditions, enabled both growth and emission reduction. In contrast, in developing countries, high social inequalities, limited institutional capacity, and financial deficiencies have restricted the effectiveness of such policies.

For instance, successful examples like the European Union's ETS system or Sweden's carbon tax have been supported by a comprehensive policy mix and a strong institutional structure (Skjærseth, 2021; Sterner, 2020). On the other hand, countries like China and India have had to balance green policies with the pressure for economic growth to meet their high energy demands (Wang et al., 2022; Chen et al., 2023).

All these findings reveal that green growth is not a single *"right path"* but varies by country. Herman et al. (2023), in their review of G7 countries, stated that despite similar policy commitments, environmental and economic outcomes differed significantly, highlighting the critical importance of contextual adaptation. Similarly, Antal and Van den Bergh (2016) emphasize that green growth can conflict with ambitious emission reduction targets, and therefore, alternative development models that question growth dependency should also be open for discussion.

Within this framework, the proposed policy set can be grouped under five main headings: First, policy instruments need to be integrated to complement each other. Carbon pricing, subsidies, social policies, and innovation incentives should be designed in a coordinated manner (Aghion et al., 2009). Second, just transition principles should be integrated into the main policy design, and protective mechanisms for low-income groups should be implemented (Bowen, 2012). Third, post-growth or agrowth approaches, aiming to move beyond a growth-centric development understanding, should be opened for discussion, especially in high-income countries (King et al., 2023). Fourth, natural capital investments—forests, water, biodiversity—should be integrated into the economy, and economic growth should be measured by the sustainability of these assets (Dinda, 2014). Finally, mechanisms for external financing, technology transfer, and capacity building should be created for developing countries, and climate funds should be directed accordingly (Shang et al., 2023).

In conclusion, while green growth has the potential to minimize the environmental and social costs of growth, achieving this requires a comprehensive transformation and policy coherence. This transformation must include political and societal paradigms as well as economic models. Only then can green growth cease to be merely a slogan and become a realistic tool for sustainable development.

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