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Applying Hood's NATO framework to quantitative text analysis in policy studies: Theory, methods, and empirical applications

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ABSTRACT

This review synthesizes international evidence on the relationship between environmental, social, and governance (ESG) factors and regional economic growth, with a specific focus on why green development policies, including ecological governance and green finance, can operate as structural drivers of long-run economic resilience. The literature has moved beyond a simple "ESG–performance" correlation toward a multi-channel view in which ESG improvements shape growth paths through productivity dynamics, innovation incentives, capital allocation, risk premia, and adaptive capacity to climate and transition shocks. At the macro and regional scales, recent work finds that ESG performance is more strongly associated with long-run income levels and medium-horizon economic activity than with short-run growth rates, consistent with the time-to-build nature of institutional upgrading and the diffusion of green technologies. At the same time, causal identification remains challenging due to ESG measurement divergence, endogenous policy adoption, and spatial spillovers, motivating a methodological shift toward cointegration, dynamic panels, spatial econometrics, and quasi-experimental designs using policy discontinuities, regulatory shocks, and instrumental variables. This review consolidates key theoretical frameworks (Porter hypothesis, directed technical change, sustainable finance equilibrium, regional resilience) and evaluates empirical advances on green finance instruments (green bonds, green credit) and environmental policy stringency. The synthesis supports a central conclusion: green development policies can enhance long-run resilience by jointly improving the efficiency frontier (innovation offsets), reducing exposure to climate and transition risks, and stabilizing investment expectations, thereby shaping the feasible set of regional development trajectories.

INTRODUCTION

The question of whether ESG factors promote economic growth has shifted from a niche debate in sustainable investing to a central problem in regional eco-

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nomics and public policy. Two developments explain this shift. First, climate and environmental constraints have become binding determinants of long-run productivity and welfare, as climate impacts increasingly appear in macroeconomic outcomes. For example, evidence on the nonlinear effects of temperature on economic production implies that climate risks are not merely environmental externalities but macro-structural forces that can permanently alter growth paths if not mitigated and adapted to (Burke et al., 2015). Second, the policy toolkit has expanded rapidly: environmental regulation is no longer restricted to command-and-control standards but includes market-based instruments, green finance architectures, and disclosure regimes that interact with private investment and innovation. In this context, "ESG" should be understood not only as a firm-level attribute but also as a measurable signal of institutional quality, regulatory credibility, and societal investment in long-horizon capabilities that shape regional growth and resilience.

A defining feature of the recent literature is a growing emphasis on time horizons. Several macro-level studies report that ESG is more strongly linked to long-run income or medium-horizon economic activity than to short-run fluctuations, aligning with the idea that institutional improvements and green technology diffusion require time to translate into observable growth (Diaye et al., 2022; Angelidis et al., 2024; Wang, Yu, & Zhong, 2023). This temporal asymmetry is crucial for regional policy: if green development policies primarily operate through long-run channels, then evaluation frameworks that focus on short-run GDP growth may systematically undervalue their benefits, especially those tied to risk reduction and resilience building.

This review addresses three interlinked objectives. First, it consolidates the theoretical foundations that connect ESG and green development policies to regional growth, emphasizing why green policies can be conceptualized as resilience-enhancing structural reforms rather than "costly constraints." Second, it synthesizes the international empirical evidence on ESG–growth relationships and on key policy levers (environmental regulation and green finance), highlighting mechanisms and heterogeneity across regions, sectors, and stages of development. Third, it evaluates methodological frontiers and proposes a research agenda that can better identify causal impacts, account for spatial spillovers, and reconcile measurement divergence in ESG data.

REVIEW PROTOCOL AND SYNTHESIS APPROACH

To meet SCI review conventions, the synthesis is structured around (i) conceptual frameworks, (ii) empirical evidence by mechanism and policy domain, and (iii) methodological issues that condition inference. The review is organized as an evidence-mapping narrative consistent with PRISMA 2020 reporting principles for transparent synthesis (Page et al., 2021). The focus is on peer-reviewed journal articles and high-quality outlets spanning environmental economics, finance, regional studies, and sustainability science. The inclusion criteria prioritize studies that (a) examine ESG or green policy measures (environmental regulation stringency, green finance instruments, green bonds, green credit, sustainable investing) and (b) link them to macroeconomic or regional outcomes (GDP per capita, economic activity indices, productivity, green growth, regional spillovers, or resilience metrics). Because ESG is measured inconsistently across providers and contexts, attention is given to studies that explicitly address endogeneity, dynamics, or measurement issues, as well as those that use credible identification strategies (cointegration, dynamic panel GMM, regression discontinuity, local projections, and meta-analysis).

The synthesis method proceeds in three steps. First, it establishes a conceptual map of channels linking ESG to growth and resilience. Second, it reviews evidence by channel, distinguishing growth-level effects (income, productivity) from growth-rate effects (short-run changes). Third, it evaluates how measurement and identification challenges shape the credibility and policy relevance of findings, highlighting what the literature can and cannot yet claim with confidence.

CONCEPTUAL FOUNDATIONS: HOW ESG CONNECTS TO GROWTH AND RESILIENCE

ESG as a Bundle of Growth-Relevant Institutional and Technological Signals

At the regional and national level, ESG aggregates information about environmental performance, social inclusion capacity, and governance quality. These components correspond to different growth-relevant assets. The environmental dimension is tightly linked to energy efficiency, pollution intensity, and exposure to climate risks; the social dimension relates to human capital formation, labor productivity, and distributional stability; and governance affects policy credibility, contract enforcement, and capital allocation. While firm-level ESG research often emphasizes cost of capital and investor

preferences, macro- and regional-level interpretations view ESG as a proxy for institutional and technological readiness for a low-carbon transition.

A key implication is that ESG can affect growth through both "efficiency frontier" channels and "risk frontier" channels. Efficiency channels raise the level of productivity through innovation, learning, and resource reallocation. Risk channels reduce volatility and downside tail risks by lowering exposure to climate shocks, regulatory uncertainty, and stranded-asset transitions. The long-run relevance of ESG is therefore not restricted to "green growth" in a narrow sense; it also includes a resilience premium arising from reduced sensitivity to adverse shocks and improved capacity for adaptation.

Porter Hypothesis and Innovation Offsets as a Micro-To-Macro Bridge

The Porter hypothesis provides an enduring theoretical bridge from environmental regulation to competitiveness and productivity by positing that well-designed regulation can induce innovation that offsets compliance costs (Porter & van der Linde, 1995). Empirical research has refined this view into "weak," "strong," and "narrow" forms, distinguishing innovation responses from productivity outcomes and emphasizing instrument design and firm heterogeneity. Large-scale evidence indicates that tightening environmental policy can yield short-run productivity gains in technologically advanced contexts and that market-based instruments are more "productivity-friendly" than rigid standards (Albrizio et al., 2017). Meta-analytic evidence further suggests that the competitiveness impacts of environmental regulation are context-dependent rather than uniformly negative (Cohen & Tubb, 2018), while review work emphasizes the importance of policy design, sectoral exposure, and innovation capacity (Dechezleprêtre & Sato, 2017).

For regional growth, the Porter logic implies a pathway: ecological governance (through credible regulation) can shift regional industrial structures toward higher productivity and cleaner technologies, raising long-run growth levels. Crucially, this mechanism depends on complementary conditions such as distance to the technology frontier, financial constraints, and the availability of innovation ecosystems. In lagging regions, similar regulation may generate short-run costs without sufficient innovation offsets, which underscores the need to connect ecological governance with green finance and capability-building strategies.

Directed Technical Change and Transition-Consistent Growth

Endogenous growth models with directed technical change formalize why policy is pivotal in steering innovation toward clean technologies. In this framework, environmental constraints create a wedge between private incentives and socially optimal innovation directions, requiring policy to redirect R&D and investment (Acemoglu et al., 2012). This theory provides a macro-consistent rationale for why green development policies can shape long-run growth: by altering relative returns to clean versus dirty innovation, policy affects the composition of technological progress and therefore the sustainability of growth itself. The model also implies that delayed action increases adjustment costs, strengthening the case for early green policy as a resilience investment.

Sustainable Finance as Capital Allocation and Risk Pricing Infrastructure

Sustainable finance theory emphasizes that ESG preferences and climate risk hedging can shift asset prices, expected returns, and real investment toward greener firms and projects. In equilibrium, green assets can have lower expected returns because investors derive non-pecuniary utility from holding them and because green assets hedge climate risk (Pástor et al., 2021). This suggests a macro channel: as sustainable investing expands, capital allocation can systematically favor firms and regions with stronger ESG profiles, lowering financing costs for green investment and accelerating structural transformation. Empirically, the rapid growth of green bond markets and evidence of pricing differentials ("greenium") indicate that sustainable finance is increasingly relevant for investment dynamics (Zerbib, 2019; Flammer, 2021; Wang et al., 2020).

Regional Economic Resilience as the Integrative Frame for Long-Run Policy Value

Regional economic resilience research clarifies why growth and resilience should be jointly analyzed. Resilience concerns a region's resistance to shocks, recovery dynamics, and long-run reorientation, not merely short-run stabilization (Martin & Sunley, 2015). ESG-related policies can influence all three components: ecological governance can reduce exposure to environmental and transition shocks; green finance can stabilize long-horizon investment and facilitate reallocation; and social and governance improvements can strengthen adaptive capacity and coordination. This integrative perspective motivates the claim that green development policies are "long-run resilience drivers" rather than only environmental measures.

Empirical Evidence on ESG and Economic Growth at Macro and Regional Scales

Long-Run Versus Short-Run Effects: Cointegration and Horizon Dependence

One of the most consistent macro findings is that ESG relates more strongly to long-run income levels than to short-run growth rates. Using panel cointegration for OECD countries, Diaye et al. (2022) report a positive long-run relationship between ESG performance and GDP per capita but little evidence of short-run effects, indicating that the growth benefits of ESG materialize over longer horizons (Diaye et al., 2022). This aligns with the notion that ESG improvements work through slow-moving institutional quality and capital formation rather than immediate demand-side stimulation.

Complementary evidence comes from studies that build aggregate ESG indices and examine predictive content for future macroeconomic activity. Angelidis et al. (2024) construct a world-based ESG index and find that ESG performance contains information about future economic activity, with a short-run negative association but a positive relationship over longer horizons, consistent with trade-offs between adjustment costs and long-run gains (Angelidis et al., 2024). Together, these findings support a horizon-based interpretation: ESG improvements can impose transition costs (e.g., reallocation, compliance) that depress short-run activity, while simultaneously raising medium- and long-run productivity and stability.

Cross-Country Evidence on Country-Level ESG Improvements and Growth Channels

Country-level ESG improvement has been linked to growth through energy efficiency, human capital, and investment channels. For an international sample, Wang, Yu, and Zhong (2023) document a positive impact of country-level ESG improvement on economic growth and discuss mechanisms including energy efficiency improvements, human-capital accumulation, and foreign investment attraction (Wang, Yu, & Zhong, 2023). This channel-based framing is important for regional development: it suggests that ESG improvements do not affect growth mechanically but through factor productivity and capability accumulation, which can differ markedly across regions.

Nevertheless, the cross-country literature also warns against over-generalization. Growth effects vary with income level, emissions structure, and resource dependence, implying that ESG policies can have different marginal returns across regional types. Resource-dependent regions may face a more complex transition because their comparative advantage is tied to carbon-intensive assets, increasing the risk of stranded capital and necessitating stronger financial and industrial policy coordination.

Regional Spillovers and Spatial Externalities of ESG Advantages

A crucial frontier is whether ESG advantages diffuse across space and affect neighboring regions through supply chains, labor markets, and agglomeration forces. Recent work uses micro-to-regional growth measures (e.g., nighttime lights) to show that ESG-advantaged firms can generate positive spillover effects on neighboring regional economic development and that such effects decay with distance (Huang et al., 2025). The implied mechanism set—green innovation, labor income, and firm agglomeration—connects ESG to classic regional growth processes, suggesting that ESG improvements can reshape local economic geography rather than simply improving firm-level outcomes.

This spillover perspective strengthens the rationale for policy coordination. If ESG-driven growth effects diffuse spatially, local green policies can generate positive externalities that spill beyond administrative boundaries, while fragmented governance can lead to underinvestment in ESG improvements from a regional welfare perspective.

GREEN FINANCE AND GROWTH: EVIDENCE, INSTRUMENTS, AND TRANSMISSION MECHANISMS

Green Finance as a Long-Horizon Investment Catalyst

Green finance is increasingly analyzed as a lever for both growth quality and resilience. Macro evidence indicates that green finance can promote sustainable development and influence growth-related outcomes by directing capital toward cleaner sectors and mitigating environmental risks (Wang, Zhao, Jiang, & Li, 2022). However, results are heterogeneous across time, policy regimes, and financial system structures, which is consistent with the view that green finance is an enabling infrastructure whose effectiveness depends on complementary regulation, disclosure quality, and project pipelines.

A recurring theme is that green finance can improve energy efficiency and accelerate renewable energy deployment, both of which support long-run productivity by reducing resource constraints and exposure to energy price shocks. Evidence from top economies supporting green finance suggests that green bonds can contribute to emissions reductions and energy efficiency improvements, though causal patterns can be weak in the short run (Rasoulinezhad & Taghizadeh-Hesary, 2022).

These findings align with the horizon dependence observed in ESG–growth studies more broadly.

Green Bonds: Pricing, Credibility, and Real Effects

The green bond market provides a concrete setting to assess whether sustainable finance changes real investment and performance. At the corporate level, evidence suggests that green bond issuance can credibly signal environmental commitment and is followed by improved environmental performance and increased ownership by long-term and green investors (Flammer, 2021). At the sovereign and market level, pricing differentials between green and conventional bonds indicate investor willingness to accept slightly lower yields, consistent with non-pecuniary preferences and/or risk hedging motives (Zerbib, 2019).

Importantly, green bond pricing and market dynamics also reveal constraints. Co-movement and spillover studies suggest that green bonds are not fully decoupled from conventional financial markets, limiting diversification benefits in some settings and implying vulnerability to broader financial shocks (Reboredo, 2018). The "greenness" and performance of green bonds can also interact with energy commodity prices, reinforcing the idea that green finance supports resilience partly by reducing, but not eliminating, exposure to fossil-fuel-driven volatility (Kanamura, 2020).

Green Finance, Innovation, and the "Growth-Quality" Trade-Off

Several studies frame green finance as affecting not only growth rates but the composition and quality of growth. Evidence indicates that green finance can promote industrial upgrading and innovation investment, thereby improving "high-quality development" dimensions even if short-run growth rates are not uniformly higher (Ouyang et al., 2023). A related line of research finds that green finance can support green technology development and carbon efficiency, but effects can differ across market conditions and time horizons (Pang et al., 2022). These results imply that green finance is most plausibly evaluated using multi-dimensional performance metrics, including productivity, energy intensity, innovation, and risk reduction, rather than short-run GDP growth alone.

Green Finance, Social Inclusion, and Sustainable Growth

The social dimension of ESG enters green finance–growth debates through inclusion and distributional stability. Evidence from OECD countries suggests that green finance expansion and green-oriented FDI can contribute to green development, while some social variables may be less directly linked to green prosperity in industry-based economies (Han & Gao, 2024). This highlights an important policy implication: green finance policies that neglect distributional outcomes may face political economy constraints that undermine long-run credibility and thereby investment stability, even when the direct macro link from social inclusion to green growth appears weak in certain samples.

ECOLOGICAL GOVERNANCE AND ENVIRONMENTAL REGULATION: PRODUCTIVITY, COMPETITIVENESS, AND RESILIENCE

Environmental Policy Stringency and Productivity Dynamics

The empirical literature on environmental regulation has converged on a nuanced conclusion: environmental policy stringency can be compatible with productivity growth, but the direction and magnitude depend on technological capability, policy design, and horizon. For OECD countries, evidence indicates that tighter environmental policy is associated with short-term productivity increases in technologically advanced contexts and that market-based instruments are relatively more favorable (Albrizio et al., 2017). This supports a conditional "strong Porter" interpretation: innovation offsets exist, but they are not automatic and may be concentrated among frontier firms.

More recent work in the euro area further evaluates these dynamics using methods designed to capture medium-horizon responses. Evidence suggests that changes in environmental regulation stringency can affect productivity growth over multi-year horizons, consistent with adjustment processes and investment cycles (Benatti et al., 2024). Such findings are directly relevant to regional resilience: productivity improvements that unfold over several years can raise a region's capacity to absorb shocks by widening fiscal and investment space, while also reducing dependence on pollution-intensive rents.

Meta-Analytic Evidence and Competitiveness Concerns

Competitiveness concerns remain a central objection to ecological governance. Meta-analytic evidence indicates that the impact of environmental regulation on competitiveness is heterogeneous and sensitive to measurement and context (Cohen & Tubb, 2018). Meanwhile, synthesis work emphasizes that trade, productivity, and innovation impacts vary by sector exposure, policy instrument, and firm characteristics (Dechezleprêtre & Sato, 2017). For regional policy, the implication is that ecological governance must be bundled with complementary measures—particularly green

finance and innovation support—to ensure that compliance costs are transformed into innovation incentives rather than persistent burdens.

Reconciling Ecological Governance With Growth: Multidimensional Perspectives

Recent research expands the Porter framework by embedding environmental policy into broader economy–environment–health nexuses and by using multidimensional productivity measures such as green total factor productivity (Sun et al., 2024). This is methodologically important because conventional productivity metrics may misclassify pollution-intensive output expansion as "growth," whereas green productivity measures internalize environmental and health costs that affect long-run welfare and resilience. For regions facing pollution-related health burdens and labor productivity losses, this reframing strengthens the argument that ecological governance can be growth-enhancing in a welfare-consistent sense.

WHY GREEN DEVELOPMENT POLICY IS A DRIVER OF LONG-RUN RESILIENCE

Climate Risk as a Macroeconomic Constraint and the Resilience Value of Mitigation

A direct rationale for green policy as resilience policy is climate risk. Evidence that temperature shocks can reduce economic production nonlinearly implies that unmanaged climate change can reduce long-run incomes substantially (Burke et al., 2015). The resilience implication is straightforward: mitigation and adaptation investments reduce the probability and severity of adverse shocks, thereby stabilizing long-run growth. Green development policy, when credible, therefore yields resilience dividends by reducing exposure to climate extremes and by shifting capital toward lower-risk technologies and infrastructures.

Crisis Performance and the Social Capital Channel

Resilience is also social and institutional. Evidence that corporate social responsibility can be associated with superior performance during financial crises suggests that trust and stakeholder relationships can function as shock absorbers (Lins et al., 2017). While this is a firm-level result, its regional implication is that places with stronger ESG norms and governance infrastructures may sustain investment and employment better under stress, supporting faster recovery. The policy takeaway is that ESG-related governance and social capacity are not "soft" objectives; they can be stabilizing assets in crisis regimes.

Investment Horizons, Uncertainty Reduction, and the Green Finance Gap

A major constraint on green transition resilience is the "green finance gap" between required and realized investments. Systems-perspective analysis emphasizes the role of policy uncertainty and short-termism as key investment barriers (Hafner et al., 2020). This connects directly to resilience: regions cannot build adaptive capacity without stable long-horizon investment. Consequently, policy frameworks that reduce uncertainty—through credible regulation, consistent taxonomy and disclosure, and de-risking instruments—can generate resilience by enabling persistent capital formation in green infrastructure and technologies.

Regional Resilience as Path Dependence and Capability Accumulation

Regional resilience theory highlights that resilience is not merely a short-run property but is shaped by long-run development paths, industrial structures, and institutional capacities (Martin & Sunley, 2015). Green development policy fits this framework because it can change path dependence by redirecting innovation and investment, thereby expanding a region's future feasible set. Regions that adopt green finance and ecological governance early may accumulate capabilities—skills, infrastructures, clean-tech clusters—that increase adaptability and reduce vulnerability to late-transition shocks such as sudden carbon pricing or trade barriers.

METHODOLOGICAL FRONTIERS: MEASUREMENT, IDENTIFICATION, AND SPATIAL INFERENCE

ESG Measurement Divergence and Implications for Macro Inference

A central methodological challenge is that ESG ratings diverge substantially across providers due to differences in scope, measurement, and weighting (Berg et al., 2022). Divergence implies that empirical results can be sensitive to the chosen ESG dataset and that cross-study comparability is limited. For macro and regional studies, measurement divergence can induce attenuation bias, spurious heterogeneity, and unstable policy conclusions. This problem is particularly severe when ESG is treated as a single index without decomposing E, S, and G components or without validating which subdimensions plausibly connect to the outcome of interest (e.g., energy efficiency versus human capital). High-quality studies therefore increasingly treat ESG measurement as part of the research design rather than as a plug-in covariate.

Dynamics, Nonstationarity, and Long-Horizon Causality

Because ESG and green policy variables are often trending and slow-moving, static regressions can be misleading. The use of panel cointegration (Diaye et al., 2022) provides one response by separating long-run equilibrium relationships from short-run dynamics. This is particularly appropriate for policies such as green finance system building and regulatory strengthening, which are not expected to produce immediate output changes but can reshape long-run capital accumulation and productivity. Dynamic panel approaches and local projections (as used in environmental regulation–productivity contexts) also help capture medium-horizon responses and transition costs.

Quasi-Experimental Designs and Policy Discontinuities

Causal identification is difficult because greener regions may adopt greener policies, creating reverse causality. Quasi-experimental approaches therefore matter for credibility. For example, regression discontinuity evidence suggests that shifts in CSR behavior can lead to improved financial performance (Flammer, 2015), providing a template for how policy discontinuities or close-call thresholds might be used in regional green policy evaluation. Similarly, instrumental variables and matched comparisons in green bond studies (Flammer, 2021) demonstrate that sustainable finance events can be analyzed with counterfactual strategies rather than purely correlational designs.

Spatial Spillovers and the Need for Spatially Explicit Growth Measures

Regional effects of ESG and green policies likely spill over through trade, migration, and supply chains. The use of spatially granular proxies such as nighttime lights to capture local economic activity, and the modeling of distance decay and spillovers, represents an important methodological advance (Huang et al., 2025). Future work can strengthen inference by combining spatial econometrics with exogenous shocks (policy pilots, staggered rollouts) and by testing whether green policy impacts propagate along specific networks (industrial linkages, transportation corridors) rather than only geographic distance.

SYNTHESIS: WHAT THE EVIDENCE SUPPORTS AND WHAT REMAINS UNCERTAIN

Three synthesis claims are strongly supported by the current international literature. First, ESG performance is more plausibly associated with long-run development levels and medium-horizon economic activity than with short-run growth rates, consistent with time-to-build mechanisms and transitional adjustment costs (Diaye et al., 2022; Angelidis et al., 2024). Second, ecological governance can be compatible with productivity and competitiveness when it induces innovation offsets and when policy design aligns incentives, but effects are heterogeneous by technological capability and policy stringency (Albrizio et al., 2017; Cohen & Tubb, 2018; Benatti et al., 2024). Third, green finance can influence growth-related outcomes by reallocating capital and reducing risk, with green bonds providing evidence of both pricing differentials and potential real effects (Flammer, 2021; Zerbib, 2019; Wang et al., 2020).

At the same time, two major uncertainties remain. The first is measurement and comparability: ESG rating divergence creates instability in empirical results, complicating policy benchmarking across regions (Berg et al., 2022). The second is causal attribution at the regional level: while recent work identifies spillovers and medium-horizon predictability, more designs that exploit exogenous policy variation and that explicitly model spatial diffusion are required before strong causal claims about regional growth can be generalized.

RESEARCH AGENDA FOR THE NEXT PHASE OF ESG–REGIONAL GROWTH SCHOLARSHIP

Future research would benefit from five concrete directions. First, studies should align ESG subdimensions to theory-driven channels, rather than relying on aggregated indices, and should triangulate across rating providers to address measurement divergence. Second, empirical designs should explicitly separate growth-level effects from growth-rate effects, using cointegration, local projections, or event-study designs that match the policy horizon. Third, green finance research should move from instrument description (green bonds, green credit) to mechanism testing, including whether cheaper capital translates into additional green investment rather than relabeling, and whether this investment improves productivity and resilience outcomes. Fourth, ecological governance research should integrate green productivity and health-adjusted measures to avoid misclassifying pollution-intensive expansion as sustainable growth. Fifth, regional studies should incorporate spatial spillover structures (networks, distance decay) and investigate cross-jurisdiction coordination failures, since the welfare gains from green policies may exceed the local gains captured by a single government.

CONCLUSION

The international literature increasingly supports a structural interpretation of ESG and green development policies: they are not simply ethical constraints or investor preferences but can function as growth- and resilience-relevant institutional infrastructures. The strongest evidence indicates that ESG improvements and green policies operate primarily through long-horizon channels—innovation, productivity reallocation, energy efficiency, capital allocation, and risk reduction—rather than through immediate output expansion. In regional terms, this implies that ecological governance and green finance can shift development trajectories by expanding adaptive capacity and lowering vulnerability to climate and transition shocks. The policy implication is correspondingly clear: green development policies should be evaluated and designed as long-run resilience investments, with complementary financial, innovation, and governance measures that convert short-run adjustment costs into durable productivity and stability gains.

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