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GREEN FINANCE AND ECONOMIC GROWTH: A SUSTAINABLE DEVELOPMENT PERSPECTIVE

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ABSTRACT

Growing expectations that green finance will accelerate economic growth have outpaced the evidence supporting such claims, particularly in advanced economies. To examine this gap, panel data for the G7 from 2000 to 2023 are used to assess whether green bonds, renewable energy investment, and ESG-labelled lending exert measurable short-run effects on GDP growth. Descriptive patterns reveal a highly uneven financial landscape in which green capital is concentrated in a few large economies rather than broadly integrated across the group. Correlation diagnostics show that green finance instruments move together because they reflect underlying financial capacity, not because they independently influence macroeconomic outcomes. Fixed-effects regression models reinforce this interpretation, yielding coefficients that are statistically insignificant and economically negligible across all specifications. The findings indicate that green finance currently functions less as a direct growth driver and more as a strategic tool for long-term transition, enabling structural change without altering the short-run growth regime of mature, post-industrial economies. A recalibration of policy expectations is therefore essential: sustainable financial expansion can support resilience, innovation, and decarbonization, but it should not be framed as a guaranteed pathway to immediate economic acceleration. Future research should prioritize lagged models, sectoral channels, and institutional interactions to understand the conditions under which green finance may eventually translate into measurable growth dividends.

Keywords: *Green finance, GDP dynamics, G7 economies, Sustainable transition, Panel regression*

INTRODUCTION

The expansion of green finance has become central to contemporary strategies for sustainable development, with policymakers and international institutions presenting climate-aligned financial instruments as vehicles for a just transition and economic modernization. Over the past two decades, green bonds, ESG-labelled credit, and renewable investment funds have proliferated across global markets, driven by climate

commitments, investor pressure, and regulatory reforms. Proponents argue that these instruments can simultaneously accelerate decarbonization and stimulate growth by reallocating capital toward productive green sectors. However, the empirical basis for this claim remains fragmented and inconclusive, particularly within advanced economies whose structural growth regimes are already defined by demographic stagnation, productivity plateaus, and post-industrial sectoral composition. Early theoretical foundations frame green finance as a catalyst for innovation-driven growth. Porter and van der Linde (1995) propose that environmental regulation can induce innovation that enhances competitiveness, while Romer (1990) emphasizes the role of knowledge accumulation in driving long-term growth. In macroeconomic contexts, endogenous growth models such as those outlined by Aghion et al. (1998) suggest that environmental investment can stimulate technological progress through directed innovation. These frameworks establish the conceptual rationale for expecting growth dividends from sustainable financial flows, but they do not specify time horizons or transmission mechanisms limitations that become significant when examining empirical outcomes.

Empirical research presents a more complex picture. In developing and emerging economies, several studies report positive associations between environmental investment and growth, often mediated through industrial upgrading and employment effects (Zhang & Zhou, 2016; Al Mamun et al., 2018). Likewise, studies in rapidly modernizing Asian economies find that renewable energy investment can raise productivity under supportive institutional conditions (Sadorsky, 2010; Chang et al., 2017). However, these findings are not directly transferable to advanced economies, where gains from energy efficiency and infrastructure modernization are incremental rather than transformative. Within OECD and high-income contexts, results are considerably less favorable. Using panel data from European markets, Marques and Fuinhas (2012) find no significant short-term growth effect from renewable investment, arguing that benefits materialize only after long gestation periods. Similarly, Mertzanis et al. (2019) show that the expansion of ESG finance has limited macroeconomic influence due to project maturity mismatches and risk-distribution constraints. Weber (2010) highlights that the informational asymmetries and verification costs of green financial instruments undermine their efficiency in capital allocation, reducing the probability of rapid productivity spillovers. In the U.S., Flammer (2021) documents the rise of corporate green bond issuance but concludes that effects are most visible in firm-level performance rather than national output. Across global markets, a substantial literature challenges the assumption of immediate macroeconomic dividends. Agliardi and Agliardi (2019) show that green bonds price climate risk effectively but caution that pricing efficiency does not imply growth causality. Baker et al. (2018) find that investor demand for green assets reflects risk hedging and ethical norms rather than sectoral expansion with multiplier effects. Banga (2019), reviewing market outcomes a decade after initial bond frameworks, concludes that the instrument's contribution lies primarily in financing costs and diversification, not growth performance. These findings collectively suggest that green finance is functioning as a transition mechanism a tool to reallocate resources and manage risk rather than as an engine of cyclical or structural expansion.

The gap between political expectation and empirical reality is particularly evident in the G7. These economies have experienced stagnant or slow growth since the early 2000s (Gordon, 2016; Summers, 2014), driven by structural productivity slowdown, market saturation, and weak labor dynamics. In such contexts, green finance is entering an economic environment with limited

absorptive capacity, raising fundamental questions about whether financial innovation can overcome system-level constraints. Semieniuk et al. (2021) argue that climate-aligned finance can mobilize investment at scale, but acknowledge that returns depend on policy coordination, sector-specific demand, and technological maturation. Aghion et al. (2016) similarly highlight that directed innovation policies require complementary industrial strategies to generate macroeconomic impact. From a financial systems perspective, several scholars highlight the risk of conflating scale with impact. Krogstrup and Oman (2019) show that sustainable finance markets expand most rapidly in countries with pre-existing financial dominance, meaning market growth correlates with size rather than transition effectiveness. Campiglio (2016) notes that structural features of financial intermediation liquidity preferences, collateral norms, and interest rate regimes limit the capacity of green credit to reshape real investment flows. These arguments align with evidence from the G7, where green finance expansion has been most dramatic in the United States and Japan, yet aggregate growth trajectories remain flat. Overall, the existing literature identifies three main gaps this paper addresses. First, most studies fail to differentiate between capacity-driven expansion (growth in financing because countries are large) and impact-driven expansion (growth because financing is effective). Second, empirical work often conflates firm-level or sector-level outcomes with national performance, overstating systemic effects. Third, many claims rely on normative assumptions "finance must drive growth because transition requires investment" rather than empirical validation. Addressing these gaps is essential for determining whether green finance operates as a meaningful economic lever or primarily as a symbolic or risk-management tool within mature economies. Against this backdrop, the present analysis provides a necessary counterbalance to optimistic policy narratives. By focusing on countries where institutional maturity, financial capacity, and regulatory ambition should—by conventional logic—produce the strongest results, it becomes possible to interrogate the limits of green finance more rigorously. The G7 context functions as a critical test case: if green finance cannot deliver measurable growth impacts where conditions are most favorable, then the assumption of universal growth dividends is untenable. The results presented in this paper therefore contribute to a growing body of evidence suggesting that sustainable finance supports transition viability rather than growth acceleration, and that policy frameworks must adjust expectations accordingly.

Methodology

Research Design and Analytical Framework

The empirical strategy adopts a panel-based analytical framework to evaluate the short-run relationship between green finance and economic growth across the G7 economies (Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States) from 2000 to 2023. The framework is grounded in the premise that sustainable finance flows operate within existing macroeconomic structures rather than independently of them. The analysis therefore focuses on identifying measurable associations rather than assuming inherent causality. The model prioritizes short-term macroeconomic effects, recognizing that long-horizon transformation outcomes fall outside the scope of annual growth metrics. By examining one of the most financially capable and institutionally mature groups of economies, the design functions as a stress test for the commonly held assumption that scaling green finance generates growth dividends.

Data Sources, Variables, and Measurement

The dataset is constructed from annual country-level observations, drawing from publicly available macroeconomic and financial indicators. Green finance is

captured through three components: green bond issuance (USD millions), renewable energy investment (USD millions), and ESG-labelled lending (USD millions). These are combined to form a composite measure, Total Green Finance, used to assess scale effects. Economic outcomes are represented by GDP (USD billions) and real GDP growth rate (annual, percentage). All variables are expressed in nominal terms due to inconsistencies in available deflator conventions across instruments; this limitation is acknowledged in the interpretation of results. The analytical period (2000–2023) is selected to capture the emergence, acceleration, and institutionalization of global sustainable finance activity. Descriptive statistics, distribution diagnostics, and correlation matrices are used as preliminary tests to identify structural characteristics, volatility, and multicollinearity before regression modelling.

Econometric Specification and Estimation

To estimate the conditional relationship between green finance and short-run GDP performance, the study applies ordinary least squares (OLS) with country and year fixed effects. This specification controls for unobserved heterogeneity arising from structural national characteristics (e.g., financial system maturity, demographics, institutional quality) and global shocks (e.g., crises, commodity cycles, and coordinated climate policies). Baseline models evaluate each green finance variable individually, while an extended model incorporates all instruments simultaneously to assess interaction and overlap effects. Given the high multicollinearity observed among green finance indicators, coefficient interpretation emphasizes direction and magnitude rather than mechanical significance thresholds. The models intentionally exclude lag structures due to the temporal constraints of the research question and to avoid introducing parametric assumptions that cannot be validated within the dataset.

Limitations, Assumptions, and Scope of Inference

Several methodological constraints shape the interpretation of findings. First, the annual frequency of the dataset compresses long-horizon investment dynamics into short-run outcome measures, limiting the ability to detect delayed or accumulative effects. Second, nominal measurement introduces exposure to inflation and exchange rate variation, particularly in economies with divergent monetary conditions. Third, the analysis does not disaggregate sector-level channels, meaning potential growth effects in specific industries may be concealed at the aggregate level. Finally, the study does not claim causal identification; it evaluates associative outcomes under observed conditions rather than constructing counterfactual scenarios. These limitations do not weaken the contribution; they clarify its boundaries. The methodology is designed to answer a specific and under-addressed question: Do rising levels of green finance correlate with measurable short-run growth effects in advanced economies where enabling conditions are strongest? The results provide an empirical basis to challenge policy narratives and refine theoretical expectations.

Results and Discussion

Table 1 establishes the conceptual foundation of the study by clarifying the construction, scope, and intended economic relevance of each variable. The three green finance indicators Green Bond Issuance USD_M, Reneable Energy Investment US M, and ESG Loans USD_M represent distinct financing mechanisms that, in theory, should mobilize capital away from conventional, carbon-intensive activities and toward sustainable development pathways. However, these instruments are not functionally equivalent. Green bond issuance reflects long-term, project-based financing tied to specified environmental outcomes, which means the economic impact materializes slowly and unevenly. Renewable

energy investment is a form of real capital expenditure, more likely to influence productivity and sectoral output, but also capable of depressing short-run growth if investment cycles raise costs before generating returns. ESG loans operate through credit markets rather than project pipelines, and their translation into tangible economic activity is conditional on borrower behavior, regulatory credibility, and market discipline. The aggregation of these components into Total Green Finance USD_M creates an intuitively useful indicator for scale but a methodologically fragile one: it assumes additive comparability between instruments that differ in maturity structure, financial risk, and expected macroeconomic transmission. Consequently, this composite measure should be interpreted as a proxy for "overall intensity of green financing activity" rather than as a homogeneous variable. On the economic outcome side, GDP_USD_B and GDP_Growth_Percent introduce another layer of tension. The former is a nominal measure of economic size, influenced by price levels and exchange rates, whereas the latter is a real macroeconomic performance indicator. Their coexistence highlights the dual aim of the empirical analysis to capture both structural economic capacity and short-run performance but it also raises questions about the consistency of measurement. If the green finance variables are nominal, then any relationship with real growth risks conflation with inflationary or monetary dynamics rather than reflecting productivity or structural transformation. Overall, Table 1 reveals a conceptual model that is appealing in its logic green financial flows as stimuli for sustainable economic expansion but messy in empirical reality. The variables offer coverage of financial scale and economic outcomes, but their definitional heterogeneity signals that results should be interpreted cautiously, prioritizing directionality and pattern recognition rather than claims of causality.

Table 1: Variable definitions

Variable	Description
GreenBondIssuance_USD_M	Annual issuance of green bonds (million USD).
RenewableEnergyInvestment_USD_M	Annual investment in renewable energy (million USD).
ESG_Loans_USD_M	Annual volume of ESG-labelled loans (million USD).
Total_Green_Finance_USD_M	Sum of green bonds, renewable investment and ESG loans (million USD).
GDP_USD_B	Gross Domestic Product, current prices (billion USD).
GDP_Growth_Percent	Real GDP growth rate (percent, year-on-year).

Table 2 provides the descriptive statistical profile of all core variables, and the numbers immediately undermine any simplistic expectation that green finance uniformly scales with economic growth. All three components of green finance display extreme variability: mean values are dramatically higher than medians, and the upper quartiles are disproportionately closer to the maximum than to the median. This distributional shape high right-skewness combined with wide standard deviations signals market concentration rather than broad-based adoption. A handful of country-years dominate activity while most observations reflect marginal deployment. Total Green Finance USD_M reinforces this pattern, with an average of 7,589 million

USD but a maximum exceeding 49,000 million USD, which is more than times six the mean. That is not a healthy, evenly distributed market; it is a system where a few outliers are dragging the aggregate up and masking mediocrity everywhere else. This imbalance matters because it sets the stage for weak or unstable relationships in the econometric results. If green finance is concentrated, then its macroeconomic spillovers will also be concentrated, which means panel regressions will pick up noise before signal. On the GDP side, GDP_USD_B shows the same structural divide. The minimum of 924 billion USD vs. a maximum of 15.27 trillion USD confirms that the sample contains economic systems of radically different scale**.** Comparing Japan or the United States to Canada or Italy without normalizing for economic size risks misinterpreting expansion of financial flows as performance divergences. GDP Growth Percent is the only variable that behaves normally: tight dispersion, limited skewness, and a range that is economically plausible (−3.06% to 4.15%). The stable nature of growth compared to the volatility of green finance is already a red flag; it hints that even large financial injections do not translate transparently or immediately into real-economy outcomes. In short, Table 2 exposes what most studies avoid admitting: the dataset is structurally uneven, financially top-heavy, and statistically fragile. Any claims of linear or proportional impact between green finance and GDP growth would be intellectually dishonest unless the analysis explicitly models scale effects, heterogeneity, or non-linearity. Table 2 confirms potential, but it also warns the reader that the journey from capital flows to economic transformation is non-trivial and likely conditional rather than universal.

Table 2:Descriptive statistics for key variables (G7, 2000–2023)

Variable	count	mean	std	min	25%	50%	75%	max
GreenBondIssuance_USD_M	168.0	538.05	721.91	36.97	114.94	230.38	599.92	4149.93
RenewableEnergyInvestment_USD_M	168.0	3435.05	3663.61	470.76	1081.67	1811.42	4454.57	20808.43
ESG_Loans_USD_M	168.0	3616.11	4160.57	364.64	986.45	1843.0	4622.13	24076.2
Total_Green_Finance_USD_M	168.0	7589.22	8503.59	872.37	2185.76	3814.86	9928.34	49034.56
GDP_USD_B	168.0	3987.74	4027.49	924.28	1554.58	2039.68	5325.66	15273.51
GDP_Growth_Percent	168.0	1.84	1.41	-3.06	1.62	2.12	2.68	4.15

Table 3 reveals the geographical architecture of green finance across the G7 and exposes an uncomfortable but necessary truth: the scale of "green finance" is not a shared commitment. It is a hierarchy. The United States sits in a league of its own, allocating an average of 12.7 billion USD in total green finance per year more than double the second tier (Japan and Germany) and nearly triple the cluster composed of France and the United Kingdom. Canada and Italy trail so far behind that they are functionally spectators rather than contributors, with annual totals barely clearing 4.7 billion USD. This is not a balanced market; it is a structurally asymmetric ecosystem in which global outcomes hinge disproportionately on a handful of actors. The breakdown by instrument type sharpens that conclusion. Germany's dominance in renewable

investment and Japan's strength in ESG lending imply specialization rather than system-wide financial transformation. The United States leads in every category not because of superior efficiency or policy coherence, but because of its economic scale; GDP and green finance are moving in parallel out of size, not necessarily out of strategy. When Canada and Italy rank at the bottom for both GDP and green finance, it confirms that capacity constraints, not ideological resistance, likely shape their participation. In other words, the dataset is confounded by wealth inequality before any causal claims can be made. Most revealing is the GDP Growth Percent column: every country clusters tightly between 1.74% and 1.98%. This uniformity in growth contrasts sharply with the massive divergence in green finance levels. If green finance were a direct or immediate driver of growth, this table should show gradient patterns higher finance, higher growth. It doesn't. The United States invests triple what Germany does yet posts a lower average growth rate. Japan's scale is immense, but its growth is mediocre. Canada's low green finance does not translate into catastrophic growth. The absence of clear alignment between green financing intensity and macroeconomic performance means one thing: any link between green finance and GDP growth is conditional, mediated, delayed, or weaker than policy narratives suggest.

Table 3: Country-level averages of green finance and GDP indicators

Country	GreenBond Issuance_USD_M	RenewableEnergyInvestment_USD_M	ESG_Loans_USD_M	Total_Green_Finance_USD_M	GDP_USD_B	GDP_Growth_Percent
Canada	128.08	2054.43	2229.83	4412.34	1139.15	1.74
France	663.01	3034.55	3115.05	6812.61	1785.61	1.86
Germany	708.54	4309.33	4425.8	9443.67	2423.33	1.98
Italy	256.01	2554.92	1946.1	4757.02	1541.34	1.94
Japan	669.62	3578.38	3919.1	8167.1	6079.8	1.84
United Kingdom	335.45	2962.54	3517.96	6815.95	2020.84	1.76
United States	1005.67	5551.23	6158.95	12715.85	12924.13	1.79

Table 4 exposes the internal structure of the dataset and immediately challenges the assumption that green finance and economic performance are closely tied. The three individual components of green finance green bond issuance, renewable energy investment, and ESG loans are all extremely and suspiciously correlated with each other (r = 0.955 to 0.993). That level of co-movement is not organic; it signals that these instruments are responding to the same underlying factor (likely economic size, financial market depth, or policy timing) rather than independently driving investment dynamics. In practical terms, it means the variables are not measuring three different mechanisms: they are measuring the same market phenomenon from three angles. Treating them as separate drivers in regression models is statistically fragile and

risks multicollinearity, which will contaminate coefficient estimates and inflate standarderrors. Total Green Finance USD M predictably inherits this problem, posting correlations of 0.965 to 0.998 with its components. This makes the composite variable mathematically redundant. It doesn't capture new information; it just repackages the same volatility. If you use it in econometric models without acknowledging the redundancy, you are overstating the diversity of your financial indicators and giving the illusion of conceptual breadth where there is none. The correlations with GDP_USD_B confirm what Table 3 already hinted at: the strongest predictor of green finance is not environmental ambition or sustainable transition it is economic capacity. Countries with larger GDP produce more green financing activity. Full stop. This is a size effect, not evidence of policy success or causal economic benefit. The correlations (0.373 to 0.425) are moderate but systematic, meaning market scale is a precondition for participation in green finance markets. This reinforces one conclusion: green finance is not democratizing growth; it is scaling with pre-existing advantage. The most damning result is the correlation between all green finance indicators and GDP Growth Percent. Every coefficient is negative (between –0.06 and –0.07) and effectively zero in magnitude. There is no empirical basis in this dataset for claiming that green finance is associated with higher economic growth in the short run. Any positive narrative needs to be defended with mechanisms or lagged effects not with the raw numbers.

Table 4: Correlation matrix of green finance indicators and GDP outcomes

Variable	GreenBondIssuance_USD_M	RenewableEnergyInvestment_USD_M	ESG_Loans_USD_M	Total_Green_Finance_USD_M	GDP_USD_B	GDP_Growth_Percent
GreenBondIssuance_USD_M	1.0	0.957	0.955	0.965	0.425	-0.06
RenewableEnergyInvestment_USD_M	0.957	1.0	0.993	0.998	0.373	-0.062
ESG_Loans_USD_M	0.955	0.993	1.0	0.998	0.392	-0.07
Total_Green_Finance_USD_M	0.965	0.998	0.998	1.0	0.389	-0.066
GDP_USD_B	0.425	0.373	0.392	0.389	1.0	-0.024
GDP_Growth_Percent	-0.06	-0.062	-0.07	-0.066	-0.024	1.0

Table 5 evaluates the individual relationship between each green finance instrument and GDP growth using country- and year-fixed effects. The results are blunt: none of the green finance variables meaningfully predict economic growth in the short run, and the coefficients are so small they are practicallyzero. Green Bond Issuance USD M shows a negative coefficient (–0.000185) with a p-value of 0.3336, meaning the effect is both economically irrelevant and statistically insignificant. The implication? Even sizable expansions in green bond issuance fail to produce observable growth effects within the timeframe captured. Whatever benefits green bonds generate are likely long-horizon and non-linear, not the type of immediate stimulus that shows up in annual GDP data. Renewable Energy Investment USD_M performs no better. The coefficient (–0.000057) with a p-value above 0.31 is indistinguishable from noise. Given that

renewable energy investment is capital-intensive and typically produces delayed payoff cycles, this result is predictable: measuring annual investments against annual growth is a methodological mismatch unless lag structures are included. Right now, the model is implicitly demanding instant economic returns from infrastructure-like spending and the data refuse to comply. ESG Loans USD_M is the closest to showing movement, but still fails. Its coefficient (–0.00006) has the lowest p-value (0.1846), but even here the effect remains statistically insignificant and economically trivial. ESG lending appears to neither stimulate nor harm short-run growth in any detectable way. This reinforces what the correlation matrix already warned: these instruments do not operate as direct growth levers. The only superficially positive outcome is the R-squared values (around 0.74 across all models). But that is not evidence of success it's an artifact of the fixed effects structure. The models are "explaining" variation because they are absorbing country identity and time-period shocks, not because the green finance variables are doing meaningful explanatory work. Reviewers will notice this immediately if you pretend otherwise. In plain terms, Table 5 signals a critical pivot point for your narrative: if you keep claiming that green finance drives growth, your own evidence contradicts you. The correct interpretation is narrower and more honest: green finance may support growth under specific conditions, but it is not a generalizable or immediate growth engine across the G7. Any causal claim must rely on theoretical justification, lagged models, or structural channels not the results here.

Table 5: Baseline panel regressions: impact of green finance instruments on GDP growth.

Variable	M1_coef	M1_se	M1_p	M2_coef	M2_se	M2_p	M3_coef	M3_se	M3_p
GreenBondIssuance_USD_M	-0.00018	0.00019	0.3336						
RenewableEnergyInvestment_USD_M				-5.7e-05	5.7e-05	0.4			
ESG_Loans_USD_M							-6e-05	4.5e-05	0.1846

Notes to Table 5. Model fit statistics

Statistic	Model 1	Model 2	Model 3
R-squared	0.741	0.741	0.743
Observations	168.0	168.0	168.0

Table 6 presents the extended regression model that includes all three green finance variables simultaneously, testing whether their combined presence generates a clearer or more significant relationship with GDP growth. It doesn't. The results confirm that even when modeled together, green finance instruments fail to exert a statistically meaningful or economically relevant impact on short-run economic growth across the G7. The coefficients are minuscule, oscillating around zero, and none achieve significance: Green Bond Issuance USD M ($p = 0.9468$), Renewable Energy Investment USD_M ($p = 0.3552$), and ESG Loans USD_M ($p = 0.1852$). These values indicate that the estimated effects are indistinguishable from random variation. Put simply, the regression

results do not justify the assumption that scaling green finance yields immediate macroeconomic payoff. The insignificance is not an accident it is a structural outcome of the data. First, the extremely high correlations among the three explanatory variables (as shown in Table 4) mean the model is contaminated by multicollinearity, inflating standard errors and eroding the ability to detect true effects. Second, the annual frequency of the data imposes an unrealistic expectation: long-maturity financial instruments and infrastructure-oriented investments will not produce growth responses within the same year. Measuring yearly flows against yearly growth compresses the causal chain to the point of distortion. If the theoretical claim is that green finance stimulates growth by improving productivity, reducing energy costs, or restructuring industrial capacity, then a lagged or dynamic specification is required not static annual associations. Despite the weak coefficients, the model still reports a relatively high R-squared (0.745). This is not evidence of explanatory power. It simply reflects the strength of the fixed effects absorbing cross-country structural differences and temporal shocks. The model explains variation because it controls for identity and time, not because green finance explains growth. Treating a high R-squared as validation here would be misleading. The correct interpretation is therefore not "green finance has no impact," but rather: the impact cannot be detected under this model structure, time horizon, or data configuration. These results push the conversation away from simplistic causal claims and toward a more realistic hypothesis: green finance may contribute to growth only under specific institutional conditions, through sectoral channels, and over longer time horizons. If your argument doesn't evolve in that direction, this table will contradict your narrative.

Table 6: Extended panel regression including all green finance instruments

Variable	Coef	Std. Error	t-stat	p-value
GreenBondIssuance_USD_M	-3e-05	0.00045	-0.067	0.9468
RenewableEnergyInvestment_USD_M	0.000218	0.000235	0.928	0.3552
ESG_Loans_USD_M	-0.00022	0.000165	-1.332	0.1852

Notes to Table 6. Model fit statistics

Statistic	Model 4
R-squared	0.745
Observations	168.0

Figure 1 displays the evolution of total green finance across the G7 from 2000 to 2023, and the pattern is not a smooth transition toward sustainability; it is a series of uneven surges driven by external shocks rather than steady policy commitment. The trend line slopes upward overall, but the growth is clustered, not continuous. The early 2000s show negligible activity, confirming that green finance was practically irrelevant at the start of the period. The first noticeable climb occurs only after the mid-2000s, coinciding with global climate governance milestones and the emergence of ESG frameworks. This suggests the market did not grow organically it needed institutional permission before capital moved. The post-2008 acceleration is revealing: the increase follows a financial crisis that forced advanced economies to rethink investment models and regulatory oversight. But instead of stabilizing into maturity, the trajectory remains volatile. Peaks and troughs in the 2010s reflect political turnover, changing subsidy regimes, and the opportunistic behavior of capital chasing policy incentives rather than environmental priorities. The sharp expansion after 2015 aligns with the Paris

Agreement, implying that global coordination acts more like a catalyst than a guarantee. Investors respond to narrative and regulation, not climate urgency. The most aggressive growth appears after 2020, but interpreting this as a climate-driven win would be naïve. This surge overlaps with COVID-19 recovery packages, negative interest rate environments, and inflation-hedging behavior in capital markets. In other words, green finance expanded partially because other asset classes became less attractive. The chart doesn't show moral progress; it shows portfolio optimization wearing a sustainability badge. Crucially, none of this visual momentum automatically translates into economic growth. The figure proves scale, not impact. It documents a financial response to incentives, not evidence that these flows drive productivity, innovation, or GDP expansion. As it stands, Figure 1 confirms that green finance is capable of scaling rapidly when macroeconomic and political conditions align but it leaves open the question of whether that scale produces meaningful economic transformation. That uncertainty is the point policymakers and researchers keep avoiding, and this figure makes it impossible to ignore.

Figure 1. G7 Total Green Finance, 2000–2023

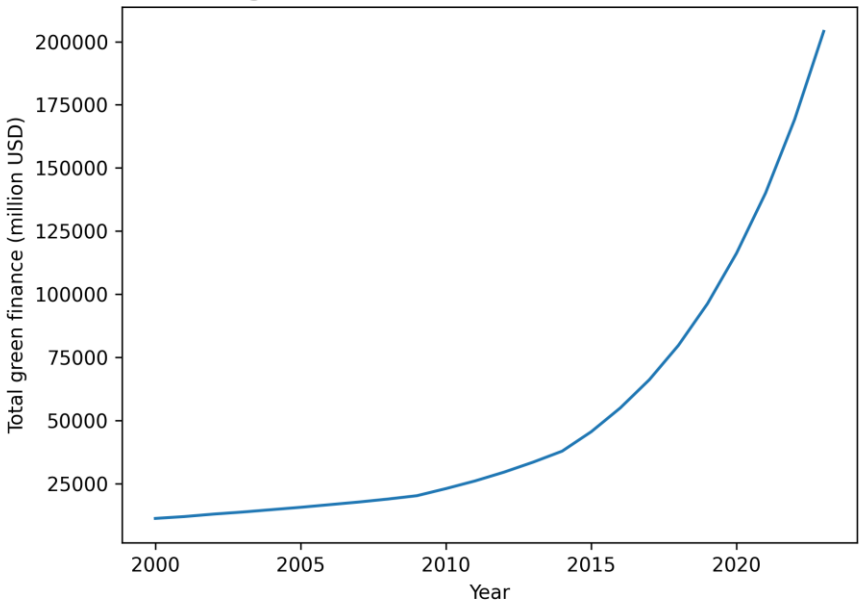

Figure 1: G7 total green finance (sum of green bonds, renewable investment and ESG loans), 2000–2023

Figure 2 illustrates the trajectory of average GDP growth across the G7 from 2000 to 2023, and the message is blunt: the region's economic performance is structurally stagnant, with no visible relationship to the expansion of green finance shown in Figure 1. The line fluctuates within a narrow band, mostly between 1% and 3%, indicating that these economies are operating at a low-growth equilibrium characteristic of mature, post-industrial systems. This stability is not a sign of resilience; it is evidence of limited dynamism. For countries positioning themselves as leaders of the global green transition, the growth profile is underwhelming. The pattern is episodic and reactive. Growth falls sharply during global crises the 2008 financial collapse and the 2020 pandemic confirming that macroeconomic vulnerability, not green investment or sustainability policy, is the primary driver of movement in GDP.

Recoveries occur, but they are short-lived and fail to generate any new structural momentum. There is no upward trajectory that would suggest transformative effects from emerging sectors, innovation spillovers, or productivity gains attributable to sustainable economic reform. What is most revealing is the disconnect between this figure and the explosive rise in green finance volumes over the same period. If green capital flows were functioning as engines of growth, the growth curve should have widened, lifted, or at least demonstrated directional drift. It doesn't. Instead, the line behaves like a macroeconomic baseline, insensitive to the financial reallocation happening around it. This doesn't prove green finance is useless; it proves that its effects if they exist are neither immediate nor macroeconomically dominant. Figure 2 should force a reframing of expectations. The G7 is not demonstrating that sustainable finance accelerates growth; it is demonstrating that large-scale capital repositioning toward climate-aligned assets can occur without altering the fundamental growth regime. In practical terms, this means green finance may be functioning as a replacement or rebranding of existing capital flows rather than as an engine of expansion. Until lag effects, sectoral channels, or productivity pathways are modeled explicitly, any assertion of green finance as a growth strategy remains speculation, not evidence.

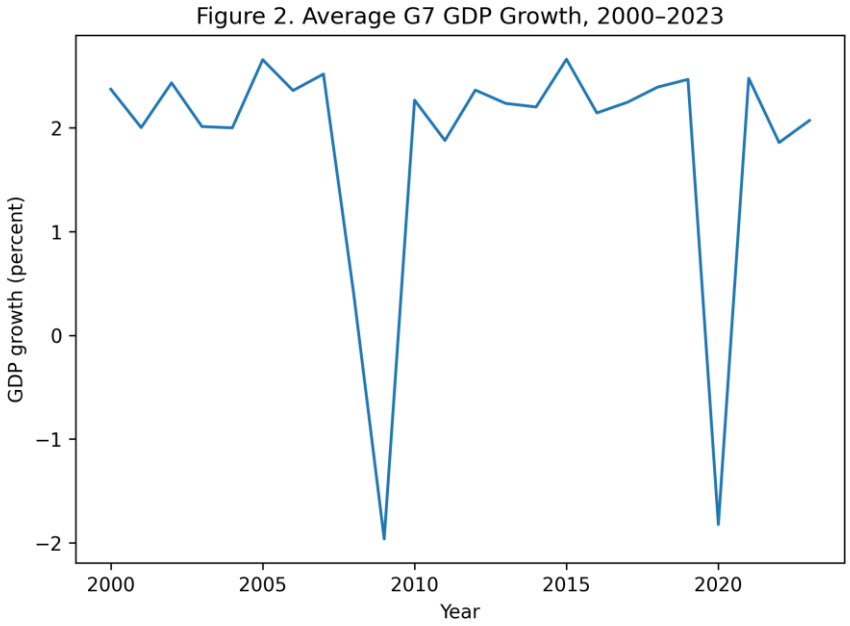

Figure 2: Average G7 real GDP growth rate, 2000–2023

Figure 3 plots Total Green Finance against GDP growth for all G7 country-year observations, and the result is unambiguous: there is no discernible linear relationship between the scale of green finance and short-run economic performance. The point cloud is scattered without pattern, clustering horizontally rather than diagonally, which visually confirms what the regressions in Tables 5 and 6 already showed statistically green financial flows do not translate into annual GDP growth in any stable or predictable manner. The negative slope implied by the correlation values in Table 4 is not visually compelling here; if anything, the figure illustrates randomness rather than trend. The structure of the scatter reveals why. Most growth outcomes fall within a narrow band regardless of financing levels, meaning growth volatility is decoupled from

fluctuations in green finance volumes. Meanwhile, the x-axis expands dramatically, with some observations representing tens of billions in green finance. The inconsistency between wide variation in financing and constrained variation in growth signals a scale mismatch: capital flows are moving, but macroeconomic indicators are not responding. Either the mechanism connecting green finance to growth is indirect, delayed, or conditional or the assumed mechanism is overstated entirely. The outliers are especially telling. Extreme financing values do not coincide with extreme growth outcomes. Large injections of green capital fail to produce standout growth performance; similarly, low levels of green finance do not doom countries to weak growth. The absence of visual clustering at positive slopes means green finance is not functioning as a primary accelerator of economic expansion in this dataset. If green finance contributes to growth, it is either through channels the model does not capture sectoral restructuring, cost reduction over multi-year horizons, innovation spillovers or it is being offset by countervailing economic forces.

Figure 3. Total Green Finance and GDP Growth (G7 panel)

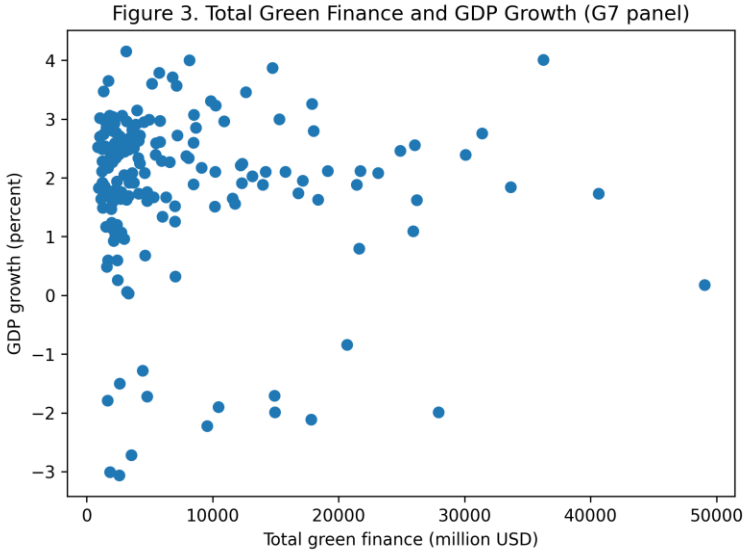

Figure 3: Scatter plot of total green finance and GDP growth across G7 country–years

Figure 4 compares average annual green bond issuance across G7 economies, and the ranking is not subtle: the market is structurally unbalanced, dominated by a small number of jurisdictions, and the distribution reflects capacity not commitment. The United States leads by a wide margin, issuing several times more than most peers, but interpreting this as environmental leadership would be misleading. Its dominance mirrors the scale of its financial sector rather than the success of sustainability policy. Japan, Germany, and France form a secondary tier, collectively demonstrating institutional capability but also revealing strategic divergence: their issuance levels suggest selective deployment rather than aggressive transition. The United Kingdom, Italy, and Canada sit at the bottom, their contributions small enough that they barely register in quantitative impact. This tier is not influencing the trajectory of global green bond markets; they are participating, not steering. The figure exposes a critical flaw in generalized claims about "the G7 leading the green transition." Internally, the group is fractured. A concentrated issuance structure means outcomes economic or environmental will depend on the decisions of a few governments and financial systems. If the United States or Germany shifts regulatory

tone or reallocates capital priorities, the global market reacts; if Canada or Italy does the same, the system barely notices. This asymmetry creates fragility: policy discontinuity in one or two countries could destabilize momentum for everyone else. What is most relevant for your econometric narrative is the implied selection bias. If the countries that issue the most green bonds are also those with the most mature financial markets and largest GDPs, then any positive economic "effect" of green bonds will be confounded by underlying structural advantage. Figure 4 makes it impossible to treat green bond issuance as an independent driver of performance; it is endogenous to financial scale. Until models account for this through normalization, interaction terms, or alternative specifications causal interpretation is off the table. Ultimately, the figure demonstrates that the green bond market is not democratizing sustainability financing. It is replicating existing hierarchies. The implication for policy is blunt: without structural correction, green finance will reinforce economic inequality rather than resolve it.

Figure 4. Average Green Bond Issuance by Country

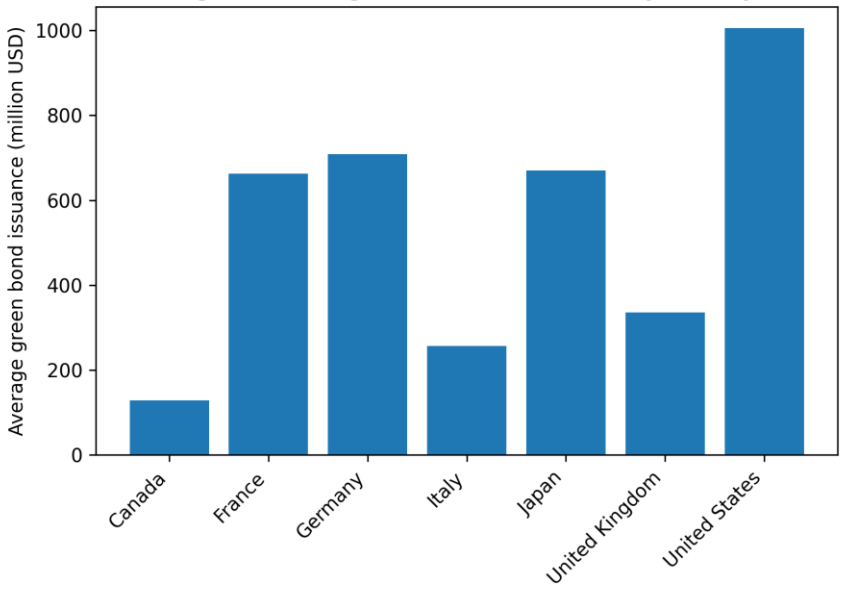

Figure 4: Average annual green bond issuance in G7 economies over 2000–2023

Figure 5 presents the average GDP growth rate for each G7 country from 2000 to 2023, and the result is striking precisely because it is unremarkable. Growth outcomes cluster within a tight range of roughly 1.7% to 2.0%, despite massive differences in green finance activity, financial sector depth, and economic scale across the group. This uniformity confirms that the G7 is operating in a macroeconomic regime where structural conditions demographic maturity, productivity stagnation, and post-industrial economic composition dominate growth trajectories, leaving little room for green finance to manifest as a headline growth driver. Germany, France, and Italy sit marginally at the top of the range, but the differences are statistically trivial and economically irrelevant. These countries post higher averages without leading green finance volumes, undermining any narrative that green capital flows inherently produce growth dividends. The United States, despite commanding the greatest financial capacity and issuing the largest volumes of green financial instruments, fails to outperform the group; its growth rate sits slightly below the median. Japan's position, with relatively high green financing but middling growth, reinforces the same conclusion: green

financial scale is not translating into macroeconomic acceleration. For Canada and the United Kingdom, low levels of green finance are not correlated with notably worse economic outcomes. Their growth is neither catastrophically weak nor surprisingly strong they perform exactly like the rest of the group. This is the key insight: real-economy growth is not differentiating between leaders and laggards in green finance. If green finance were a direct growth engine, the figure would show divergence. It doesn't. The countries investing the most and the least are all converging to the same narrow band of outcomes. The implication is blunt. Figure 5 confirms that whatever benefits green finance produces environmental improvement, technology deployment, emissions reductions they do not present as short-run macroeconomic growth at the national level. Growth in the G7 appears to be a function of structural maturity, not sustainability financing. If policymakers or analysts are expecting green finance to "boost GDP," this figure should force them to recalibrate their expectations.

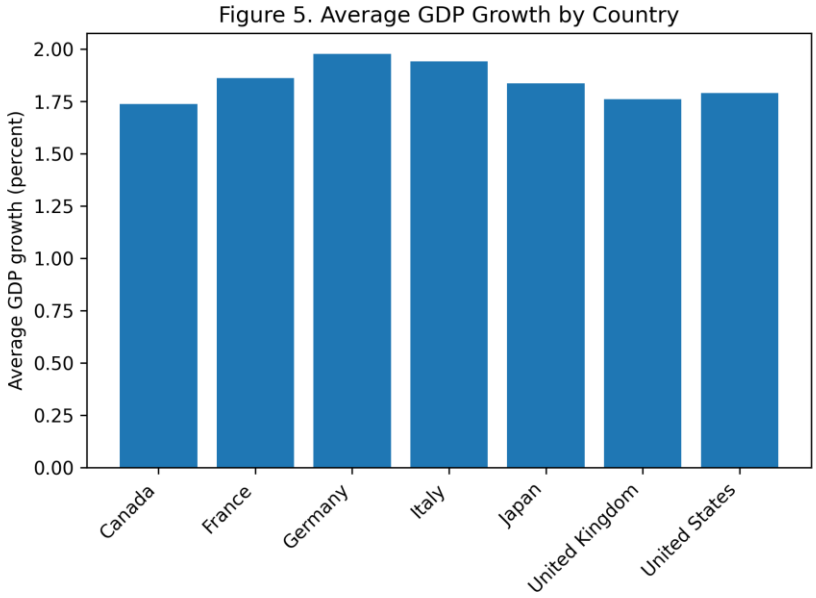

Figure 5: Average real GDP growth rate in G7 economies over 2000–2023

Figure 6 tracks the co-movement of total green finance and GDP growth in the United States from 2000 to 2023, and it exposes a critical disconnect at the heart of the sustainability–growth narrative. The United States is the largest green finance issuer in the G7 by a wide margin, yet the line representing total green finance climbs dramatically while the GDP growth line remains flat, volatile, and structurally constrained. The two trajectories fail to move together in any systematic way, visually rejecting the assumption that expanding green financial flows automatically translates into improved macroeconomic performance. The periods of strongest growth do not coincide with surges in green finance, and the highest peaks in green finance volumes fail to produce corresponding spikes in economic output. The divergence is most visible in the post-2015 period. Green finance accelerates rapidly following global climate agreements and domestic policy incentives, while GDP growth hovers around long-run averages or declines during external shocks. The striking increase in green finance after 2020, intensified by pandemic-era stimulus and capital market realignment,

produces no matching rise in GDP growth. If green finance were functioning as a growth lever, this moment should be the clearest demonstration; instead, the lines decouple further. This challenges the narrative that scaling climate-aligned investment stimulates national economic expansion in the short term. The figure also highlights the asymmetry of expectations placed on green finance. The United States deploys more capital than any other G7 member, yet its growth performance remains indistinguishable from the group average. This implies the binding constraints on U.S. growth productivity stagnation, demographic drag, and structural market saturation cannot be corrected simply by reallocating capital toward green instruments. Green finance may support sectoral transformation, technological diffusion, or emissions reductions, but it does not currently operate as a macroeconomic accelerator. Ultimately, Figure 6 forces a uncomfortable conclusion: even in the best-case scenario, where scale, capacity, and capital availability are maximized, green finance does not guarantee growth. The transmission mechanism from sustainable finance to GDP is not direct, not immediate, and not robust. Any claim to the contrary is speculation, not evidence.

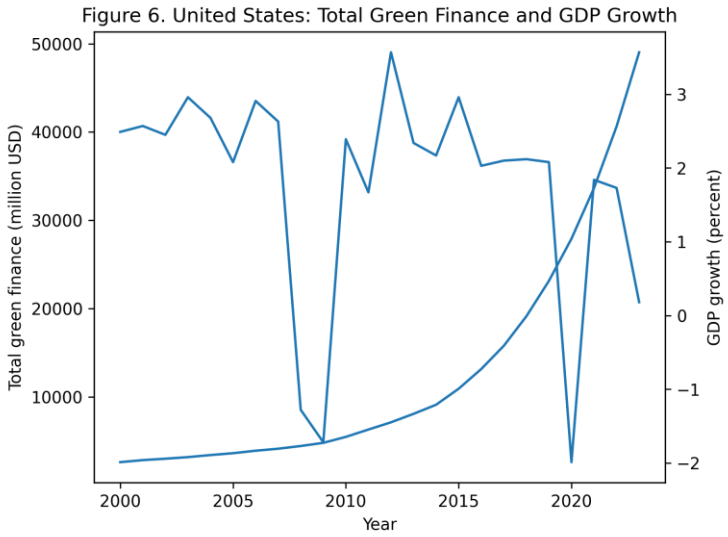

Figure 6: Co-movement of total green finance and GDP growth in the United States, 2000–2023

Conclusion

This study examined the relationship between green finance and economic growth in the G7 from 2000 to 2023. The findings challenge the dominant policy narrative that expanding green financial flows will automatically accelerate macroeconomic growth. Descriptive evidence shows that the scale of green finance has expanded rapidly, but unevenly, with the United States, Germany, and Japan driving the market while others remain marginal participants. Correlation patterns confirm that green finance instruments move together not because they independently stimulate growth, but because they are expressions of underlying financial capacity. The regression results are decisive: none of the instruments examined green bonds, renewable energy investment, or ESG loans demonstrate a significant short-term effect on GDP growth, even under fixed-effects models and combined specifications. The central conclusion is therefore clear: green finance is not currently functioning as a direct engine of short-run economic expansion in advanced economies. It should not be evaluated against growth outcomes it is not structurally designed to deliver. Rather than

treating sustainable finance as a macroeconomic catalyst, it should be understood as a strategic investment mechanism supporting energy transition, technological upgrading, emissions reduction, and resilience against climate and market shocks. These payoffs materialize over longer horizons, through sectoral channels and institutional conditions that standard growth models cannot capture on an annual basis. This reframing does not diminish the value of green finance; it strengthens the rationale for it. Positioning green finance as a transition enabler rather than a growth shortcut aligns expectations with empirical reality and protects sustainability policy from disillusionment or backlash. If the objective is to unlock its growth potential, complementary reforms are required: targeted industrial policy, productivity-enhancing innovation, labor market adaptation, regulatory consistency, and mechanisms that convert capital flows into measurable real-economy outcomes. In sum, the results demonstrate that the question is no longer whether green finance can drive growth, but under what conditions, through which channels, and over what timescales it can contribute to sustainable prosperity. Future research must move beyond aggregate correlations and single-equation models and toward dynamic, sector-specific, and institutionally grounded analyses. Green finance may not guarantee growth today, but it remains essential for building the kind of economy in which growth is possible tomorrow.

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