SUSTAINABILITY REPORTING, GREEN FINANCE, AND GOVERNANCE QUALITY ON FINANCIAL PERFORMANCE: A MEDIATION ANALYSIS APPROACH

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Abstract
The aim of the study is to examine how sustainability reporting, green finance, and quality of governance affect the financial performance of developing economies using digital transformation as a mediating variable. The study makes use of Ordinary Least Squares (OLS), Fixed Effects (FE), Random Effects (RE) and Panel-Corrected Standard Errors (PCSE) estimation models to craft a robust study by employing a balanced panel dataset of 44 developing economies in 6 geographic regions (2015-2024). Sustainability reporting has adjusted net savings percentage of GNI as a proxy, renewable energy consumption as a proxy of green finance, government effectiveness as a proxy of governance quality and internet penetration as a proxy of digital transformation and GDP per capita growth as a financial performance, respectively. The result of Hausman tests proves the suitability of the specification of fixed effects. Empirical evidence indicates that the three independent variables, which include sustainability reporting, green finance and governance quality all have a major positive impact on financial performance. More significantly, these relationships are influenced partly by digital transformation which increases the transfer of sustainability and governance benefits to economic growth outcomes. The research adds new panel evidence to the literature on sustainability-finance nexus and has significant policy implications to the developing world that aims at advancing the integrated sustainability and digital nexus.
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1. INTRODUCTION
The nexus of sustainability, governance, and financial performance has received growing academic interest in the wake of the 2015 Paris Treaty, the United Nations Sustainable Development Goals (SDGs), and the educational creation of Task Force on Climate-related Financial Disclosures (TCFD). In the case of developing economies, in specific, overcoming the dual challenge of economic growth and environmental responsibility is one of the foremost challenges of good governance in the modern times. How much sustainability practices at the national level, green financial commitments and institutional quality of governance are converted to empirically quantifiable commitments of financial performance, and the channels by which this transmission can or cannot

be achieved is an empirically under-explored question in the extant body of literature.

The macro level of sustainability reporting is the level of national economic activity that takes the costs of the environment, resource depletion, and ecological degradation. The adjusted net savings which is a composite measure formulated by the world bank which removes the expenses of the loss of health caused by the damage of particulate emissions to gross national savings offers a strong country-level proxy of sustainability accounting practices. The high adjusted net savings in countries indicate the ability to balance economic growth and environmental liability, and this aspect indicates strong sustainability governance frameworks on the institutional level. Green finance, measured by the ratio of renewable energy use to total final energy, is the extent to which economies are transforming their energy systems to sustainable and low-carbon infrastructure, which is broadly written as being the key factor behind long-run financial resilience (Taghizadeh-Hesary and Yoshino, 2019).

The quality of governance measured by the government effectiveness index by the World Bank includes perceptions of quality of the public services, independence of the civil service, the quality of the policy formulation and the quality of the commitment of the government to the policies. There is a general theory to have strong governance institutions as the means of creating externalities that have a positive impact on the economy; that it lowers the transaction costs and enhances investor confidence, as well as creates the environments that can lead to the sustainable inflow of investments (Kaufmann et al., 2011). The governance quality of the situation is more consequential in the case of the developing economies, since in many cases, it is the weak institutions that become the most significant barrier to the transfer of the resource endowments and the reform agendas into the real financial results.

One of the dimensions of this framework has been the mediating role of the digital transformation which has remained a critical area lacking proper studies. The high rate of spread of digital infrastructure - which in this case is represented by penetration of internet as a percentage of the population - essentially changes the channels by which sustainability commitments and governing effectiveness are converted into financial performance. The digital channels make sustainability data collection and reporting cheaper, increase transparency and accountability of the governments, mediate the flows of green finance, and increase the process of spread of productive technologies in sectors. According to recent research, digital transformation is not only a force of its own growth, but an enabling multiplier that increases the economic returns on the sustainability and investment in governance (Yoo et al., 2021; Cheng et al., 2022).

Although there is increasing empirical research on the links between sustainability and finance, cross-country panel research that merges sustainability reporting, green finance, quality of governance, and digital transformation within a single mediation framework is limited, especially on developing economies. Most of the available researches are either firm-based in nature, single-country based or bivariate in terms of the relationships but do not consider any mediating process. To fill these gaps, this study will use a constructed balance panel dataset of 44 developing economies in six geographic regions namely Sub- Saharan Africa, South Asia, East Asia and the Pacific, Latin America and the Caribbean, the Middle East and North Africa and Europe and Central Asia, between 2015 and 2024.

This research study have three main contributions to the literature. To begin with, it has given macro-level cross country panel evidence of the sustainability-finance nexus that adds to the firm-based corpus of existing research. Second, it directly theorizes digital transformation as a mediating process, which sheds light on how sustainability and governance gains are mediated into economic performance. Third, it utilizes a strict multi-model estimation plan, OLS, FE, RE and PCSE, which considers unobserved heterogeneity, serial correlation, heteroscedasticity, and cross-sectional dependence, and hence empowers the soundness and credibility of the empirical results.

2. LITERATURE REVIEW
2.1 Sustainability Reporting and Financial Performance

The sustainability reporting and financial performance relationship were studied widely on the firm level, and most of the studies report positive relationships between the quality of ESG disclosures and financial performance, including return on assets, Q Tobin, and market capitals (Friede et al., 2015; Eccles et al., 2014). At the macro level, evidence is more disputable, however. Empirical work, using country-level sustainability indicators (assessed by adjusted net savings, ecological footprint, and environmental performance indices) typically reveals that countries which are characterized by stronger sustainability frameworks have better performance in the long-run (in economic, rather than environmental) aspects (Dietz and Neumayer, 2007; Arrow et al., 2012). The adjusted net savings measure, especially, has been confirmed as a prospective indicator of true wealth growth that represents the long-term financial sustainability of the national economies (Hamilton and Clemens, 1999, World Bank, 2021). Those countries that are frequently registered to experience high adjusted net savings, translating to the economy not being offset by the depletion of the environment, are usually characterized to have more resilient and sustainable long-run growth curves.

In more contemporary literature, the mediator aspect of institutions and transparency has been added to this question. Ioannou and Serafeim (2012) believe that sustainability reporting brings about informational spillovers, which boosts investor confidence and diminishes informational asymmetries that reduces the cost of capital at the national level. This macroeconomic channel is especially applicable to developing economies, in which informational deficiencies are one of the less desirable obstacles to the entry of foreign investments. Based on this reasoning, Lins et al. (2017) determine that companies and economies severely affected by the sustainability commitment saw their stock prices drop less during crisis times, further indicating that sustainability has created financial resilience value in their natural growth state.

2.2 Green Finance and Economic Growth
The concept of green finance, which is in the broadest sense the delivery of financial services and products in a manner that can be described as supporting environmentally sustainable economic activity, has become a key point of focus in the global sustainability development agenda. In a thorough review of green finance mechanisms developed by Taghizadeh-Hesary and Yoshino (2019), they highlight the following as the main mechanisms through which green finance directs capital to low-carbon economic operations; renewable energy investment, green bonds, environmental tax, and sustainable banking. Renewable energy use as a share of final energy use in the country level displays a widely used proxy of the extent of green finance commitment because energy transition investments form the largest single share of total green finance flows across the world (International Energy Agency, 2022).

Empirical data about development impacts of renewable energy investment is widely favorable of a positive relationship, at least in medium term perspective. Apergis and Payne (2010) record a two-way directional causality on the consumption of renewable energy and the growth of economies in a panel of 13 OECD countries, with more recent studies that extend the analysis of the same to the contexts of developing economies having generally found positive but heterogeneous causes (depending on the level of development of financial sector and institution capacity) (Kahia et al., 2017; Bhattacharya et al., 2016). The growth channel or renewable energy mechanism functions in various ways, such as the energy security benefits which can mitigate the need of imports, technological externality arising in the renewable industries, job creation in the clean energy sector, and cost of environmental liability that can lower the deadweight loss attracted by the fossil-fuel-related growth models.

2.3 Governance Quality and Financial Performance
The quality of governance presence has long been under the microscope of institutional economics as one of the key preconditions of economic outcomes. North (1990) contends that the institutions, i.e., the rules, norms and enforcement mechanisms, that determine the form of economic interaction, are the key determinant of cross country variation in

economic performance in the long run. Most popular empirical proxies of institutional quality have taken the form of the World Bank Governance Indicators (Kaufmann et al., 2011), among which government effectiveness is a major component. The meta-analyses on the empirical literature on governance and growth confirm positive significant effect of government effectiveness on economic performance with estimates showing that one standard deviation improvement on governance leads to about two and three percentage points of increment in the yearly growth (Acemoglu et al., 2001; Rodrik et al., 2004).

The quality of governance in the context of sustainability acts as a direct cause of financial performance and one of the conditions upon which sustainability practices bring about economic returns. Poor governance conditions are linked with increased costs of corruption, low compliance with environmental standards, less believable credentials of sustainability, and lower shareholder confidence all which dilute the financial returns to sustainability outlay. On the other hand, good governance institutions provide the enabling conditions where sustainability reporting generates informational credibility, green finance intermediation is efficient and digital transformation investments realizes their productive potential.

2.4 Digital Transformation as a Mediator

Digital transformation as a mediating mechanism in the nexus between sustainability and finance has become a key issue in the recent literature. Yoo et al. (2021) state that the digital infrastructure essentially reorganizes the informational fabric of the islands of economies, minimizing the cost of sustainability data collection, data transfer, improving the degree of transparency of the governance process, and promoting the appearance of digital green finance platforms. Internet penetration the share of internet users among the total population is the most readily available and empirically tested proxy of digital transformation at the nation level, in both the level of the digital infrastructure, and the rate of the population engagement in the digital economy.

The study conducted by Cheng et al. (2022) offers direct empirical support of the role of digital transformation as a mediator in relation to

environmental regulation and firm performance in a Chinese environment and demonstrates that digital adoption boosts the positive impact of regulatory stringency on financial performance significantly. Applying the same line of reasoning to the macro level, Imran et al. (2023) record a positive channel flow between investments in renewable energy use via digital infrastructure to economic growth, across a sample of Asian economies. Such results can be attributed to a theoretical framework that postulates that the financial cost of operation of sustainability governance and the financial cost information of sustainability governance is lower in the case of the digital transformation, which increases the gains of the economy to sustainability and governance investment.

2.5 Research Gap and Hypotheses

Although the theoretical and empirical literature above has shown a certain abundance of knowledge, a cross-country panel study that combines all of sustainability reporting, green finance, quality of governance, digital transformation, and financial performance under a mediation framework specifically designed in relation to the developing economies is a gap in the literature that exists. This study fills this gap in that it helps to develop the following research hypotheses:

H1: Sustainability reporting has a significant positive effect on financial performance in developing economies.

H2: Green finance has a significant positive effect on financial performance in developing economies.

H3: Governance quality has a significant positive effect on financial performance in developing economies.

H4: Digital transformation mediates the relationship between sustainability reporting, green finance, governance quality and financial performance.

3. DATA AND METHODOLOGY
3.1 Sample and Data Sources

The research uses a balanced panel data of 44 developing economies that have been selected through the classification of low-income, lower-middle-income, and upper-middle-income economies of the World Bank. The sample includes

six geographic areas: Sub-Saharan Africa (14 countries), South Asia (5 countries), East Asia and the Pacific (6 countries), Latin America and the Caribbean (7 countries) and the Middle East and North Africa (5 countries) and Europe and Central Asia (7 countries). The timeframe of the study is 2015 2024, which is 440 country-years of a balanced panel. All the variables are retrieved through World Development Indicators (WDI) and Worldwide Governance Indicators (WGI) databases provided by the World Bank giving data comparability and consistency within the country setting.

3.2 Variable Operationalization

The operationalization process of the variables of this study entails the process of converting abstract concepts into measurable proxies or indicators that can then be quantified and analyzed. To take an example, sustainability reporting can be assessed based on the Adjusted Net Savings where particulate emission damage is positioned as a percentage of the Gross National Income (GNI). The proportion of consumption of renewable energy to total final energy captures green finance. The quality of governance is determined by the Government Effectiveness Index of the World Bank, whereas the digital transformation is mentioned in the percentage level of people who use internet. The GDP per capita growth annually measures the financial performance.

Variable	Proxy Indicator	Source
Sustainability Reporting	Adjusted Net Savings incl. Particulate Emission Damage (% of GNI)	WDI / World Bank
Green Finance	Renewable Energy Consumption (% of Total Final Energy)	WDI / World Bank
Governance Quality	Government Effectiveness Index (Score)	WB Governance Indicators
Digital Transformation	Individuals Using the Internet (% of Population)	WDI / World Bank
Financial Performance	GDP per Capita Growth (Annual %)	WDI / World Bank

These proxies enable a programmatic evaluation of the different aspects of sustainability, governance, digital transformation, and economic performance.

3.3 Econometric Strategy

The research uses a hierarchic estimation approach to have robustness of results of the panel. Pooled OLS is employed to determine the relationships of the baseline specification to be unconditional. Times-invariant country heterogeneity that is unobserved is then controlled by fixed Effects (FE) estimation. Random Effects (RE) estimation is also said to allow extrapolation of the results to the general population. Hausman (1978) specification test is used to establish the preferred specification between FE and RE. To take care of cross-sectional dependence, heteroscedasticity and serial correlation, which are typical of data at macro-level panel, the ideal specification will utilize Panel-Corrected Standard Errors (PCSE) in the fixed effects model, following Beck and Katz (1995).

The primary estimation equation takes the following form:

$$GDPG_{it} = \alpha + \beta_1 ANS_{it} + \beta_2 RE_{it} + \beta_3 GE_{it} + \beta_4 INT_{it} + \varepsilon it$$

where $GDPG_{it}$ denotes GDP per capita growth for country i in year t; ANS_{it} denotes adjusted net savings; RE_{it} denotes renewable energy consumption; GE_{it} denotes government effectiveness; INT_{it} denotes internet users; and ε_{it} is the idiosyncratic error term. Mediation analysis follows the Baron and Kenny (1986) procedure, with bootstrapped indirect effect estimation to assess the statistical significance of the mediating pathway through internet penetration.

4. RESULTS AND INTERPRETATION
4.1 Descriptive Statistics

Table 1: Descriptive Statistics

Variable	N	Mean	Std. Dev.	Min	Max	Skewness
Adj. Net Savings (% GNI) [IV1]	440	6.84	2.41	-4.21	18.73	0.42
Renewable Energy (%) [IV2]	440	43.27	26.18	0.61	96.48	-0.18
Gov. Effectiveness Index [IV3]	440	-0.52	0.38	-1.87	0.56	-0.08
Internet Users (%) [MEDIATOR]	440	39.14	18.32	3.14	91.23	0.31
GDP per Capita Growth (%) [DV]	440	3.42	4.28	-18.65	12.14	-0.74

All variables sourced from World Bank WDI and WGI databases. ANS = Adjusted Net Savings; RE = Renewable Energy Consumption; GE = Government Effectiveness; INT = Internet Users; GDP Growth = GDP per Capita Growth. Summary statistics computed for the full balanced panel.

Table 1 provides descriptive statistics of all five panel variables using the 440 country-year observations. Dependent variable, GDP per capita growth, has a mean of 3.42% and standard deviation of 4.28 percentage points which is considerable variance in financial performance, across countries and over time, as one would expect even with a 44 country sample of the developing economy. The skewness (-0.74) of the number is negative, indicating the effect of the negative occurrence of growth shocks, which was most evident in the year 2020 due to the COVID-19 pandemic that afflicted the world and predisposition to the economy of the developing countries, which have limited fiscal space to react to negative growth.

Its adjusted net savings (IV1) is 6.84 percent of GNI, or an average of developing economies in the sample is making modestly positive sustainability-adjusted wealth, but with a standard deviation of 2.41 which suggests that there is a lot of heterogeneity. The large variation between -4.21% and 18.73 indicates the radical variations in the cost internalization of the environment between resource-extractive economies with highly negative adjusted savings to those that perform sustainability reforms well. The consumption of renewable energy (IV2) has an average of 43.27 percent of total final energy consumption, which is high when compared to other countries in the world, as it represents the use of biomass and hydropower in the energy pattern of most of the countries in the low-income category of the African and South Asian regions. Government effectiveness (IV3) has the mean of -0.52, which is in line with the anticipated shortcomings in governance, which are typical of emerging economies. Internet penetration (MEDIATOR) has the average value of 39.14 and the positive trend in time series in the sample period of 2015-2024 represents the current digital transformation of the emerging economies.

4.2 Correlation Analysis

Table 2: Pearson Correlation Matrix

Variable	(1)	(2)	(3)	(4)	(5)
(1) Adj. Net Savings	1.000				
(2) Renewable Energy	0.214***	1.000			
(3) Gov. Effectiveness	0.187***	0.132**	1.000		
(4) Internet Users	0.243***	0.156**	0.418***	1.000	
(5) GDP p.c. Growth	0.312***	0.228***	0.267***	0.198***	1.000

*** p < 0.01, ** p < 0.05, * p < 0.10. Correlations computed using pairwise complete observations from the full balanced panel (N = 440).

Table 2 shows the Pearson correlation table of all study variables. This gave rise to a number of interesting trends. There is a preliminary bivariate support of all four hypotheses with adjusted net savings ($r = 0.312$, $p < 0.01$), renewable energy consumption ($r = 0.228$, $p < 0.01$), government effectiveness ($r = 0.267$, $p < 0.01$), and internet penetration ($r = 0.198$, $p < 0.01$) having significant and positive correlations with GDP per capita growth (DV). The highest pairwise correlation of the independent variables is between government effectiveness and internet penetration ($r = 0.418$, $p < 0.01$), which is theoretically intuitive the more effective governments are the more they are expected to focus on digital infrastructure investment but

stresses the need to control the two variables in the multivariate model.

Notably, the three independent variables have moderate, statistically significant but far below causes of concern, inter-variable correlations (all $r < 0.25$). This is also supported by the Variance inflation factor (VIF) diagnostics check as indicated in Table 3 that assure the nonexistence of problematic multi alike correlations by the estimation framework. The fact that adjusted net savings and renewable energy ($r = 0.214$) are positively related is in line with the assumption that those countries that have better sustainability governance systems are also those that pursue energy transition agendas.

4.3 Diagnostic Tests

Table 3: Panel Diagnostic Tests

Diagnostic Test	Statistic	p-value	Decision
Hausman Test (FE vs. RE)	chi2(4) = 18.42	0.001***	Use FE
Breusch-Pagan LM Test (RE vs. OLS)	chi2(1) = 124.38	0.000***	RE preferred over OLS
Wooldridge Serial Correlation Test	F(1,43) = 14.62	0.000***	Serial corr. present
Modified Wald Test (Heteroscedasticity)	chi2 (44) = 213.74	0.000***	Heteroscedasticity present
VIF Adj. Net Savings	1.18	—	No Multicollinearity
VIF Renewable Energy (IV2)	1.24	—	No Multicollinearity
VIF Gov. Effectiveness	1.31	—	No Multicollinearity
VIF Internet Users	1.42	—	No Multicollinearity
Cross-Sectional Dependence (Pesaran CD)	CD = 8.34	0.000***	CSD present; PCSE applied

*** $p < 0.01$, ** $p < 0.05$. Hausman test: chi-squared with 4 degrees of freedom. Breusch-Pagan LM test: tests for random individual effects. Wooldridge test: tests for first-order serial correlation in panel data. Modified Wald test: tests for group-wise heteroscedasticity in FE residuals. Pesaran CD test: tests for cross-sectional dependence. VIF values computed from pooled OLS estimation. PCSE = Panel-Corrected Standard Errors.

In Table 3, the extensive set of panel diagnostic tests is reported, which guides the relevant estimation strategy. Hausman specification test has reported chi2 (4) = 18.42 (p =0.001), which has decisively rejected null hypothesis of no systematic difference between FE and RE estimators. This finding substantiates the existence of correlation between

the country-specific effects that cannot be observed and the explanatory variables, and the Fixed Effects estimator is identified as the best specification to use in comparison to the Random Effects. The Breusch-Pagan Lagrange Multiplier test (chi2 (1) = 124.38, p < 0.000) conclusively proves that pooled OLS should not be followed and instead individual effects panel

structure is used, which confirms the use of panel structure in this study.

The panel data serial correlation Wooldridge-test results F (1,43) = 14.62 (p = 0.000), which indicates that the tests contain first-order serial correlation in the idiosyncratic errors i.e. a typical feature of macro-level panel data with an annual frequency. The Modified Wald test of heteroscedasticity of groups gives chi2 (44) = 213.74 (p < 0.000), or heteroscedasticity of the group error variance is demonstrated. The Pesaran CD test (CD = 8.34, p < 0.000) further identifies the existence of cross-sectional dependence, indicating that unobserved

shocks of the world like commodity price fluctuation, crisis of a financial nature, and the COVID-19 pandemic, produce correlated country panel residual. These combined diagnostic findings encourage the use of Panel-Corrected Standard Errors (PCSE) as a desirable robust estimation approach with simultaneous capability to account for the following: heteroscedasticity, serial correlation and cross-sectional dependence. VIFs are all less than 1.5, and well under the traditional limit of 10, indicating the investigation of the nonexistence of Multicollinearity.

4.4 Regression Results: OLS, Fixed Effects, Random Effects, and PCSE

Table 4: Regression Results

Variable	OLS (Baseline)	Fixed Effects	Random Effects	FE-PCSE (Robust)
Adj. Net Savings	0.312*** (0.084)	0.287*** (0.091)	0.298*** (0.088)	0.294*** (0.079)
Renewable Energy	0.048** (0.021)	0.041* (0.024)	0.044** (0.022)	0.046** (0.019)
Gov. Effectiveness	1.842*** (0.312)	1.614*** (0.348)	1.728*** (0.328)	1.762*** (0.291)
Internet Users	0.067*** (0.018)	0.058** (0.022)	0.062*** (0.019)	0.064*** (0.016)
Constant	1.284** (0.524)	–	1.108* (0.612)	–
Observations	440	440	440	440
Countries	44	44	44	44
R-squared (Within)	0.314	0.342	0.328	0.356
Country FE	No	Yes	No	Yes
Year FE	No	Yes	No	Yes
PCSE Correction	No	No	No	Yes

Dependent variable is GDP per capita growth (annual %). Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. FE-PCSE denotes Fixed Effects with Panel-Corrected Standard Errors. Country and year fixed effects included in FE and FE-PCSE models. Hausman test confirms FE preference over RE. R-squared reported is within R-squared for FE models.

Table 4 shows the core regression findings in four estimation specifications. The findings are very consistent in all the models which gives good evidence of the strength of results. The effect of adjusted net savings (IV1) on GDP per capita growth is strong in all the four specifications. The preferred version of FE-PCSE model has a coefficient equal to 0.294 (p < 0.01), which means that an increase in the adjusted net savings as a fraction of GNI by one percentage point would be accommodated by an increase in the annual GDP per capita growth by about 0.29 percentage points, holding other factors constant. This result is in line with the theoretical

hypothesis that experience of better sustainability reporting systems translates into better long-term monetary functioning in that they maintain the productive foundation base and lessens the concentration of environmental liabilities (Hamilton and Clemens, 1999).

The consumption of renewable energy (IV2) has a strong positive impact on financial performance, but with a lesser coefficient magnitude (0.046, p 0.05 in the FE-PCSE model). This result suggests that a one percentage point absorption rise in the proportion of the final energy consumed by renewable energy is linked to approximately 0.046 percentage point of

further GDP per capita development. Although small in size, the meaning and regular occurrence of this effect in all four models give support to H2 and lies in line with other larger literature on green finance-growth. The coefficient is significantly lower than expected, since investments in energy transition often face very prolonged gestation periods before they can start showing observable effects in terms of GDP growth, and the 2015-2024 coincidence period only captures the dynamic transition process in many developing economies.

The coefficient of government effectiveness (IV3) is the strongest of the three independent variables (1.762, p < 0.01 in FE-PCSE), which proves the point H3 and stresses the pivotal role of the institutional quality in the financial performance of the developing economies. This result holds in line with the institutional economics literature, and implies that governance reform is the most profitable sustainability investment that can be made by developing economy policymaker. The change in the coefficient of the effective government, which is 0.842 (OLS) to 0.614 (FE) in the PCSE model and that was 1.762 in the OLS specification, is the absorption of the government persistence by the country fixed-effects (resulting in a partial recovery of the coefficient by the PCSE model, which stood at 0.842) indicates that the coefficient absorbs country fixed-effects instead of cross-sectional variations in governance.

The internet penetration (MEDIATOR), too, pops up into any of the specifications with high coefficients of positive sign of the FE-PCSE value of 0.064 (p < 0.01), meaning that percentage point increase in internet users as a share of the population results in a percentage point growth in GDP per capita of 0.064. This direct effect and the results of mediation test reinforce the hypothesis that the digital transformation is an independent factor responsible of financial performance and an increase in terms of economic returns to sustainability reporting, green finance, and quality governance investments. The within-R-squared of 0.356 of FE-PCSE model suggests that the all four variables together account for the within-country growth in GDP per capita by explaining about 35.6 percent of the variation, a decent strength of macro-level explaining power of such a parsimonious model.

There is partial mediation of internet penetration pathway revealed by mediation analysis. Baron and Kenny procedure tests show that the direct effects, adjusted net savings to GDP growth, renewable energy to internet penetration, and government effectiveness to GDP growth have significant indirect effect = 0.019, bootstrapped 95 percent CI: [0.008, 0.034), = 0.011, and = 0.028, respectively. These findings help confirm H4 and prove that digital transformation is an effective amplification channel to which sustainability and governance benefits can be passed on to financial performance outcomes.

5. DISCUSSION

The theory and practice applications have some important implications to the empirical findings of this study. Theoretically, the findings give macro-country confirmation of the sustainability-finance nexus, which has been reported to occur largely at the firm level. The positive and significant estimates on all three independent variables, including sustainability reporting, green finance, and quality of governance, in four estimation specifications and 440 observations across 44 developing economies validate that the use of sustainability practices provides a set of economic dividends of financial performance on the national level. This result supports the World Banks authentic savings model as a practically consistent theory model of sustainable development funding which has been proved to be empirically valid.

Of interest especially is the fact that the effect of the quality of governance yields the greatest financial performance effect amongst the three independent variables. The government effectiveness is expected to improve by one standard deviation to cause (corresponding to an improvement in the index in this sample of about 0.38) an increase in annual GDP per capita growth of about 0.67 percentage points, at a FE-PCSE coefficient of 1.762. This is a greater effect than the direct effects together of sustainability reporting and green finance implying that the institutional reform is the enabling condition that sustainability finance frameworks have to be constructed. Such investments might yield less financial payoff to developing economies that seek to develop economies of scale by engaging

in green finance and sustainability reporting reforms without proper governance infrastructure to fund and run since weak institutions can hide the economic channels through which the sustainability practices can generate value.

This picture is provided with a significant dynamic level by the mediation findings. It is the digital transformation (proxies by internet penetration) that cannot only have a direct positive influence on financial performance, but also determines how the three independent variables influence the dependent variable. The partial mediation finding holds that digital infrastructure increases but to something not completely replaces the direct financial returns to sustainability and investment in governance. It has significant policy sequencing implications since investments in digital infrastructure which are not accompanied by similar reforms in sustainability reporting and in governance reforms may not have the growth dividend that is implied by the examples of mediation pathway documented here.

The heterogeneity of the region that is incorporated in the sample of 44 countries deserves extra comment. Sub-Saharan African economies (the largest regional subsample) are likely to have the highest percentage of renewable energy consumption (biomass and hydropower), but the lowest scores on government effectiveness, which gives out a tendency where the endowment of green energy gets under met. The South Asian economies, such as Pakistan, Bangladesh, and India, have moderate-quality governance and comparatively low internet penetration, implying that the expansion of digital infrastructure is the major limitation to the fulfillment of financial returns on the continued sustainability reforms in this area.

6. CONCLUSION AND POLICY IMPLICATIONS

This study has explored how sustainability reporting, green finance, and the quality of governance is related to financial performance in 44 developing economies during 2015-2024, where digital transformation is a mediating variable. Through rigorous panel estimation results, OLS, Fixed Effects, Random Effects and PCSE results as well as substantial complement of diagnostic tests the study discovers strong and consistent confirmation that all three sustainability dimensions have significant positive effects on GDP per capita growth and the effect is partially mediated through digital transformation.

These findings have a number of policy implications. To begin with, reforms of sustainability accounting (such as the implementation of adjusted net savings monitoring frameworks and integrated national reporting from the perspective of the SDGs) must be viewed by policymakers of developing economies as a priority in financial development, but not as an environmental necessity. The empirical findings of the above case have shown that sustainability accounting has generated viable economic returns as an important argument that sustainability reporting should mainstream in development planning. Second, green finance mobilization, including renewable energy investment incentives, green bond markets, and climate finance intermediation are a potential approach to the improvement of financial performance, even though the coefficient of renewable energy consumption is relatively small, which leads to the need to think of the complementary governance and institutional reforms to unleash all the growth potential of energy transition investment.

Third, and most to the point, the quality of governance reform becomes the best payoff sustainability investment in the developing economy scenario. Governance capacity building (reform of the public services system, regulatory quality improvement, anti-corruption measures) should be targeted as the basis of an investment by international development institutions and bilateral donors so that sustainability finance can generate financial returns. Fourth, digital investment infrastructure must be regarded as sustainability multiplier and not as independent economic development mechanism only. The findings of the mediation indicate that emerging economies that both pursue the raising of digital change and maintaining sustainable governance reforms will reap enhanced financial performance returns, through the compounding effect of these two streams of complementary investment.

The research has various limitations that indicate directions on which future research can take place.

To start with, internet penetration as a single-item proxy of the internet transformation is not entirely multidimensional enough to characterize the digital transformation force in countries; future researchers ought to consider composite digital transformation measures that reflect mobile banking penetration, e-government services, and facilitation of digital trade. Second, the use of annual data in the study could distort high-frequency dynamics in the sustainability-finance nexus - panel vector auto regression designs based on annual data, which they can use when annual data is not available, would allow more high-resolution causation analysis. Third, country-level analysis inevitably brings a certain level of heterogeneity in sustainability practices in the firm to the forefront, multilevel modeling frameworks that combine firm-level ESG data with country level governance indicators and digital indicators are an emerging direction of future research.

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