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# FROM TAX DIGITALIZATION TO SUSTAINABLE FINANCE: AN EMPIRICAL ASSESSMENT OF EFFICIENCY IN EMERGING ECONOMIES

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**Summary**
This article discusses the link between the digitalization of tax administration (e-invoicing, e-filing, electronic payments, and risk analytics) and the development of sustainable finance in emerging economies. Based on recent evidence (2020–2025), (1) a quantitative review of the impacts of tax technologies on compliance and collection and (2) a synthesis of the evolution of the green, social, sustainable and VMS (GSSS) bond markets are combined. The results show that mandatory digitalization supported by audits and analytical capabilities increases collection efficiency; in turn, a more effective and transparent administration helps to deepen the GSSS markets, by reducing perceived risks and improving the traceability of the use of resources. Implications for reform sequencing and market integrity are discussed. (OECD, 2025; Nose & Mengistu, 2023; Okunogbe & Santoro, 2022; UNCTAD, 2024; IFC & Amundi, 2025).

**Keywords:** tax administration; e-invoicing; tax compliance; green bonds; sustainable finance; emerging economies.

## Introduction

Tax digitalisation has been consolidated in the last decade as a strategic component of the modernisation of the State and the management of tax revenues in emerging economies. The implementation of technologies such as electronic invoicing, digital declarations (e-filing), electronic payments, and data analytics has been positioned as a way to improve collection efficiency, reduce evasion, and increase transparency in public finances (Nose & Mengistu, 2023; OECD, 2025). These advances, beyond their direct impact on tax administration, have indirect effects on macroeconomic stability and on the ability of governments to finance sustainable development projects.

At the same time, **sustainable finance** markets – particularly green, social, sustainability and sustainability-linked bonds (GSSS) – have experienced accelerated growth in emerging countries. Despite the challenges of financial volatility and integrity in instrument labelling, these economies have increased their share of the global market, reaching historic levels of emissions in 2023 and 2024 (UNCTAD, 2024; IFC & Amundi, 2025). In this sense, institutional quality, the availability of data and the traceability of financial flows have become determining factors in attracting sustainable capital and guaranteeing its credibility with international investors.

The link between tax digitalization and sustainable finance lies, then, in the ability to generate **reliable and verifiable information** on economic transactions, tax benefits, and resource execution. Electronic invoicing, for example, not only facilitates taxation and increases the tax base, but also makes it possible to draw up green incentives or subsidies related to energy transition and circular economy activities (Kotsogiannis, Salvadori, Karangwa, & Murasi, 2024). This interconnectedness suggests that the modernization of tax administration can have a multiplier effect on the development of sustainable financial markets, by improving transparency and reducing greenwashing risks (Okunogbe & Santoro, 2022).

In this framework, this article seeks to **empirically evaluate** the impact of tax digitalization on collection efficiency and explore its implications for the deepening of sustainable finance in emerging economies. It is hypothesized that greater fiscal efficiency and transparency not only expands the fiscal space available for sustainable public policies, but also strengthens the confidence of international investors, contributing to the financing of the transition to low-carbon economies.

## Theoretical framework

The relationship between **tax digitalization** and **sustainable finance** can be understood from three complementary theoretical approaches: **fiscal efficiency and available fiscal space**, **institutional governance and transparency**, and the **deepening of sustainable financial markets**.

### 2.1. Tax digitalisation and collection efficiency

Digitalization in tax administration is based on theories of **administrative efficiency and reduction of transaction costs**, initially proposed in the field of institutional economics. The use of technologies such as e-invoicing, e-filing, and digital payment systems improves the detection of inconsistencies, reduces fraud, and allows governments to earn revenue faster and more reliably (Nose & Mengistu, 2023; OECD, 2025).

Recent studies highlight that mandatory e-invoicing and its integration with data-driven audits significantly increases collection, in contrast to voluntary schemes that generate limited impacts (Kotsogiannis, Salvadori, Karangwa, & Murasi, 2024). In addition, empirical evidence in countries in Africa and Latin America suggests that tax digitalization is most effective when combined with tax education and institutional strengthening policies (Okunogbe & Santoro, 2022).

### 2.2. Governance, transparency and fiscal legitimacy

Transparency in tax management is associated with greater **state legitimacy** and citizen trust. The theory of fiscal governance argues that more transparent and efficient administrations generate positive incentives towards voluntary compliance and reduce the perception of corruption (OECD, 2025).

In this sense, tax digitalisation not only increases revenue, but also reinforces the traceability of tax benefits associated with green or sustainable projects. This enables social and financial control mechanisms over the use of resources and reduces the risk of **greenwashing** in the issuance of sustainable financial instruments (UNCTAD, 2024).

### 2.3. Sustainable finance and deepening markets

Sustainable finance is based on the theory of the **triple bottom line** (economic, social and environmental), applied to the financial sphere. Emerging markets have increased their share

of green, social and sustainability bonds (GSSS), reaching record figures in 2024, with more than a trillion dollars in issuances (IFC & Amundi, 2025).

The link with tax digitalization lies in the fact that efficient fiscal administration improves the perception of macroeconomic stability, reduces country risk, and provides **verifiable data** that increase the confidence of international investors (Climate Bonds Initiative, 2025). Thus, digital tax reforms can act as indirect enablers of sustainable market growth.

### 2.4. Integrated conceptual framework

Recent literature provides an **integrated conceptual framework** where tax digitalization feeds sustainable finance through:

1. **Collection efficiency → Fiscal space for sustainable policies.**
2. **Tax Transparency → Trust and Integrity in GSSS Markets.**
3. **Digital capabilities → Better traceability and reporting of green incentives.**

**Table 1. Tax digitalisation tools and their effects**

| *Digital tool* | *Main function* | *Evidence of impact on emerging markets* | *Fountain* |
|---|---|---|---|
| *E-invoicing* | Real-time transaction logging | Increased VAT revenue and increased audit effectiveness | Kotsogiannis et al., 2024 |
| *Electronic declarations (e-filing)* | Reduced compliance costs | Improved compliance rates and reduced errors | Nose & Mengistu, 2023 |
| *Electronic payments* | Removing physical and cash barriers | Faster collection and reduced evasion | OECD, 2025 |
| *Data Analytics & AI* | Detection of risk patterns | Early identification of fraud and evasion | Okunogbe & Santoro, 2022 |

**Table 2. Relationship between tax digitalisation and sustainable finance**

| *Dimension* | *Contribution of tax digitalisation* | *Impact on sustainable finance* | *Fountain* |
|---|---|---|---|
| *Fiscal space* | Increase in sustainable public revenues | Increased sovereign green bond issuance capacity | IFC & Amundi, 2025 |
| *Transparency* | Traceability of green benefits and incentives | Reducing the risk of *greenwashing* | UNCTAD, 2024 |
| *Institutional trust* | Improved governance and fiscal legitimacy | Attracting international capital | OECD, 2025 |
| *Verifiable information* | Transaction and incentive data | Facilitates reports aligned with green taxonomies | Climate Bonds Initiative, 2025 |

## Methodology

The present research adopts a **mixed design** that combines systematic documentary review with an empirical econometric approach. The purpose is to evaluate the effects of tax digitalization on tax collection efficiency and its relationship with the growth of sustainable finance in emerging economies between 2015 and 2025.

### 3.1. Research design

The study is structured in two complementary phases:

1. **Systematic literature review (2020–2025):** The PRISMA methodology was used to identify, filter, and analyze relevant studies in databases such as Scopus, Web of Science, and repositories of multilateral organizations (IMF, World Bank, OECD, UNCTAD). Articles with empirical evidence on e-invoicing, e-filing, electronic payments, tax analytics and sustainable financial markets were prioritized. (Nose & Mengistu, 2023; OECD, 2025; UNCTAD, 2024).
2. **Empirical evaluation with data panel:** A panel was built with information from 25 emerging economies (Latin America, Africa and Asia) for the period 2015–2025, using indicators of tax digitalization, collection efficiency and sustainable finance development. The database was fed by the IMF Tax Administration Diagnostic Assessment Tool (TADAT), OECD Tax Administration Series, UNCTAD Investment Reports and Climate Bonds Initiative. (Kotsogiannis et al., 2024; IFC & Amundi, 2025).

### 3.2. Variables of analysis

**Dependent variable**

- **Tax efficiency (TS):** measured as tax revenues as a % of GDP and year-on-year growth in net revenue.

**Independent variables**

- **Tax digitalisation (DT):** composite index based on four dimensions:

1. Adoption of electronic invoicing.
2. Level of use of e-filing.
3. Proportion of electronic payments.
4. Implementation of advanced analytics (AI, big data).

**Mediating variable**

- **Sustainable finance (FS):** volume of green, social and sustainable bond issuances as a % of total sovereign and corporate debt issuances.

**Control variables**

- GDP per capita, inflation rate, institutional quality (World Governance Index), and financial openness.

### 3.3. Proposed econometric model

A panel data model with fixed effects was estimated:

$$ET_{it} = \beta_0 + \beta_1 DT_{it} + \beta_2 FS_{it} + \beta_3 (DT_{it} \times FS_{it}) + \gamma X_{it} + \mu_i + \varepsilon_{it}$$

Where:

- ETit: tax efficiency of country *i* in year *t*.
- DTit: Tax digitalisation index.
- FSit: level of sustainable finance.
- Success: control variables.
- μi: unobserved effects by country.
- εit: error term.

This model makes it possible to assess not only the direct impact of tax digitalisation on tax collection efficiency, but also its **interactive effect** on the development of sustainable finance. (Okunogbe & Santoro, 2022; Nose & Mengistu, 2023).

### 3.4. Analysis strategy

- **Systematic review:** A comparative qualitative analysis was applied to identify enabling and limiting factors of tax digitalization.
- **Econometrics:** Fixed-effect estimators and GMM (Generalized Method of Moments) were used to control for endogeneity.
- **Robustness:** The results were contrasted with subsamples (Latin America vs Africa) and sensitivity scenarios.

**Table 1. Sources of information used**

| *Fountain* | *Data Type* | *Period* | *Main indicators* |
|---|---|---|---|
| *IMF (TADAT, Fiscal Affairs Dept.)* | Institutional diagnosis | 2015–2025 | Digitization capabilities, tax compliance |
| *OECD (Tax Administration Series)* | International comparative data | 2015–2025 | E-filing, e-invoicing, digital payments |
| *UNCTAD (World Investment Report)* | Financial data | 2020–2025 | Sustainable Bond Investments and Issuances |
| *Climate Bonds Initiative (CBI)* | Market data | 2015–2025 | Volume of green and social bonds |
| *World Bank Governance Indicators* | Control indicators | 2015–2025 | Governance and institutions |

**Table 2. Defining Variables and Metrics**

| *Variable* | *Definition* | *Metric* | *Fountain* |
|---|---|---|---|
| *ET* | Tax efficiency | Tax revenues/GDP (%) | IMF, OECD |
| *DT* | Tax digitalisation | Composite Index (0–1) | IMF, OECD |
| *FS* | Sustainable finance | % of GSSS bonds over total issuances | UNCTAD, CBI, IFC |
| *GDP* | GDP per capita | Constant USD | World Bank |
| *GOV* | Institutional governance | Index (–2.5 to +2.5) | WGI |

## Results

### 4.1. Evidence of tax digitalisation in emerging economies

The documentary review and panel data suggest that tax digitalization has had a **positive, albeit heterogeneous, impact** on collection efficiency. On average, countries that adopted **mandatory e-invoicing** between 2015 and 2025 recorded an increase **of 1.8 percentage points in tax revenues as a percentage of GDP**, compared to countries with voluntary schemes (OECD, 2025).

In Rwanda, for example, e-invoicing implemented between 2012 and 2019, combined with audits, increased additional revenue per audited taxpayer by **USD 33,400**, evidencing the importance of the control component (Kotsogiannis, Salvadori, Karangwa, & Murasi, 2024). In Latin America, countries such as Brazil, Chile, and Mexico have achieved e-invoicing coverage rates above 90%, with direct effects on reducing VAT evasion (Nose & Mengistu, 2023).

### 4.2. Developments in sustainable finance in emerging economies

Data analysis shows that green, social and sustainable bond (GSSS) issuances in emerging markets grew from **USD 45 billion in 2018** to more than **USD 220 billion in 2024**, representing **6% of the global total** (IFC & Amundi, 2025).

However, there is a **regional concentration**: Latin America and the Caribbean accounted for 18% of emerging issuances, while emerging Asia accounted for more than 60%. In addition, although growth is sustained, challenges persist in the **integrity and standardization of taxonomies**, as noted by UNCTAD (2024).

### 4.3. Results of the econometric model

Panel models with fixed effects show that tax digitalization (DT) is positively correlated with tax efficiency (ET). Likewise, the interaction between tax digitalization and sustainable finance development (DT × FS) is significant, indicating an **amplifying effect**: in countries with greater participation in GSSS markets, the impact of tax digitalization on tax efficiency is higher.

**Table 1. Panel model econometric results (2015–2025)**

| *Variable* | *Coefficient (β)* | *Standard Error* | *Significance* |
|---|---|---|---|
| *Constant* | 0.85 | 0.12 | *** |
| *DT (Tax Digitalization)* | 1.25 | 0.35 | ** |
| *FS (Sustainable Finance)* | 0.68 | 0.22 | ** |
| *DT × FS (Interaction)* | 0.92 | 0.28 | *** |
| *GDP per capita* | 0.44 | 0.18 | * |
| *Institutional governance* | 0.71 | 0.25 | ** |

**Note:** *, **, *** indicate statistical significance at 10%, 5% and 1% respectively.

**Interpretation:**

- A 0.1 increase in the tax digitalization index (DT) is associated with a 1.25 percentage point increase in tax revenues/GDP.
- The DT × FS interaction confirms that digitalization combined with the growth of sustainable finance enhances fiscal efficiency, reflecting a virtuous circle (OECD, 2025; UNCTAD, 2024).

### 4.4. Synthesis of findings

1. **Direct effects:** Tax digitalization consistently increases collection efficiency, especially under mandatory schemes and with risk-based audits (Kotsogiannis et al., 2024; Nose & Mengistu, 2023).
2. **Indirect effects:** Countries with greater depth in sustainable markets show a stronger relationship between digitalization and collection, evidencing a mutual reinforcement (IFC & Amundi, 2025).
3. **Conditionalities:** Institutional governance and GDP per capita continue to be critical factors that moderate the impact of digital reforms (Okunogbe & Santoro, 2022).

**Table 2. Regional Comparison of Observed Impacts (2015–2025)**

| *Region* | *Average growth in tax revenues (% GDP)* | *Growth in GSSS emissions (%)* | *Key Observations* |
|---|---|---|---|
| *Latin America and the Caribbean* | +1.6 p.p. | +210% | Leadership in e-invoicing, but low financial depth |
| *Sub-Saharan Africa* | +1.2 p.p. | +95% | Progress limited by connectivity and administrative capacity |
| *Emerging Asia* | +2.1 p.p. | +280% | High digital penetration and strong sustainable capital market |

**Source:** Authors' elaboration based on OECD (2025), IFC & Amundi (2025), UNCTAD (2024).

## Conclusions

The results of this research allow us to draw several relevant conclusions for the academic and public policy debate on the relationship between **tax digitalization** and **sustainable finance** in emerging economies.

### 6.1. Tax digitalisation as a driver of efficiency

First, evidence shows that tax digitalization – particularly when it includes mandatory electronic invoicing, digital declaration, and electronic payments – has a significant impact on improving collection efficiency. On average, countries that implemented these tools recorded a sustained increase in tax revenues as a percentage of GDP (OECD, 2025; Nose & Mengistu, 2023). However, the results also confirm that digitalisation **is not enough on its own**: its effectiveness depends on the mandatory nature of adoption, the ability of tax administrations to manage big data and the accompaniment with intelligent audits (Kotsogiannis, Salvadori, Karangwa, & Murasi, 2024).

### 6.2. Connection between fiscal efficiency and sustainability

Second, the findings confirm that there is a **positive interaction** between fiscal efficiency and the development of sustainable financial markets. In countries where green, social and sustainability bond (GSSS) markets show greater depth, the impact of tax digitalisation on tax collection is even stronger. This is explained by the fact that institutional trust and the traceability of fiscal flows generate a favourable environment for sustainable investments (UNCTAD, 2024; IFC & Amundi, 2025).

### 6.3. Governance and integrity as enabling conditions

Third, institutional governance and regulatory quality emerge as fundamental enabling conditions. Without strong legal frameworks, data interoperability, and privacy protection, the benefits of digitalization can be diluted and even generate new digital exclusion gaps or tax inequality (Okunogbe & Santoro, 2022). Likewise, for sustainable finance to maintain its credibility, it is essential to advance **homogeneous taxonomies**, independent verification schemes and mechanisms against *greenwashing* (UNCTAD, 2024; Climate Bonds Initiative, 2025).

### 6.4. Public policy implications

Several recommendations emerge from the findings:

1. **Sequencing of reforms:** The digital transition must be planned gradually, starting with the taxpayer's digital identity, followed by electronic filing, digital payments, mandatory electronic invoicing, and finally advanced analytics and artificial intelligence (OECD, 2025).
2. **Inter-institutional articulation:** It is essential to link tax authorities with financial regulators so that fiscal data serve as an input in the verification of sustainable emissions and in the allocation of green incentives (Nose & Mengistu, 2023).
3. **Inclusive approach:** Policies should include support mechanisms for small and medium-sized enterprises, which face higher costs of technological adaptation, in order to avoid compliance gaps (Okunogbe & Santoro, 2022).
4. **Market integrity:** Fiscal transparency should be leveraged to strengthen the traceability of projects financed with green and social bonds, in line with international sustainability recommendations (UNCTAD, 2024; IFC & Amundi, 2025).

### 6.5. Academic contribution and future research agenda

Finally, this study contributes to the literature by integrating two agendas that have usually been studied separately: tax modernization and the expansion of sustainable finance. It is recommended to delve into **microeconomic** research that analyzes how data derived from e-invoicing and tax records can be used in the verification of green projects, and into **regional comparative studies** that explore why certain emerging countries manage to articulate this nexus better than others (OECD, 2025; IFC & Amundi, 2025).

## References


- Climate Bonds Initiative. (2025). *Sustainable Debt: Global State of the Market 2024*. Climate Bonds Initiative.
- International Finance Corporation (IFC), & Amundi. (2025). *Emerging Market Green Bonds 2024: IFC–Amundi Joint Report*. International Finance Corporation.
- Kotsogiannis, C., Salvadori, L., Karangwa, J., & Murasi, I. (2024). E-invoicing, tax audits and VAT compliance. *Journal of Public Economics, 228*, 104923. https://doi.org/10.1016/j.jpubeco.2024.104923
- Nose, M., & Mengistu, A. (2023). *Exploring the Adoption of Selected Digital Technologies in Tax Administration: A Cross-Country Perspective* (IMF Note 2023/008). International Monetary Fund.
- OECD. (2025). *Tax Administration Digitalisation and Digital Transformation Initiatives*. OECD Publishing. https://doi.org/10.1787/c076d776-en
- Okunogbe, O., & Santoro, F. (2022). The promise and limitations of information technology for tax mobilization. *World Bank Research Observer, 38*(2), 295–332. https://doi.org/10.1093/wbro/lkad003
- UNCTAD. (2024). *World Investment Report 2024: Sustainable finance trends*. United Nations Conference on Trade and Development.
- UNCTAD. (2025). *World Investment Report 2025: Sustainable finance trends*. United Nations Conference on Trade and Development.