Digital Taxation Innovation for MSMEs to Support a Circular and Inclusive Economic Ecosystem

Yunita Sari Rioni, Dwi Saraswati, Roro Rian Agustin

Abstract
Developing digital taxation innovations that focus on improving tax compliance and revenue, but also on creating a circular and inclusive economic ecosystem. It is hoped that this will encourage MSMEs to transform into tax-compliant, environmentally-oriented businesses that are able to compete in a sustainable digital ecosystem. This study uses a mixed method with a sequential explanatory design, which begins with quantitative data collection and analysis, followed by qualitative exploration to deepen understanding of the quantitative findings. This approach was chosen to capture both the objective (numbers and statistics) and subjective (perceptions, context, and field dynamics) aspects of the phenomenon of digital taxation of MSMEs in supporting a circular and inclusive economy.

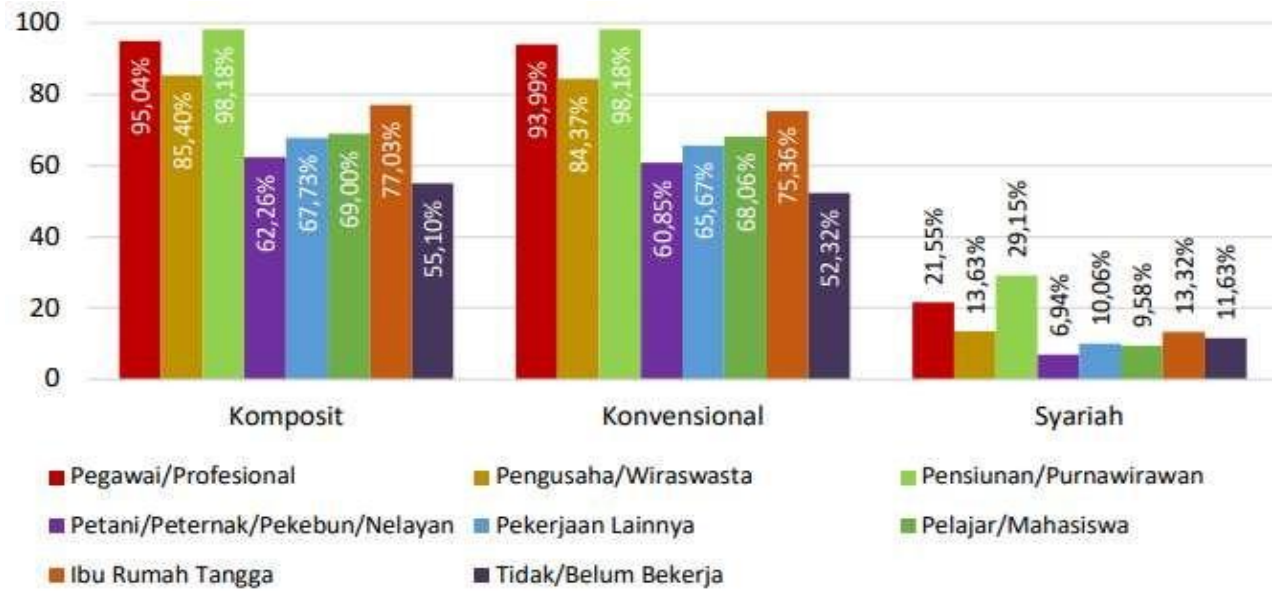
Keywords: Digital Taxation, Innovation, MSMEs, Circular, Inclusive, Economic Ecosystem

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e-mail:dwisaraswati@dosen.pancabudi.ac.id[2], rororian@dosen.pancabudi.ac.id[3] 2nd International Conference on Islamic Community Studies (ICICS)
Theme: History of Malay Civilisation and Islamic Human Capacity and Halal Hub in the Globalization Era
https://proceeding.pancabudi.ac.id/index.php/ICIE/index

Introduction

Digital financial transformation is important in developing MSMEs. MSMEs play a strategic role in driving national and regional economic growth. MSMEs contribute around 61.1% to the Gross Domestic Product (GDP) and employ more than 97% of the workforce. In Medan City, there are more than 300,000 MSME business units, which form the foundation of the local economy and drive social inclusion. However, the contribution of of SMEs to national and regional tax revenue remains low. The tax contribution of MSMEs in 2022 is only around 1.8% of total national tax revenue. The low level of tax compliance among MSMEs is caused by various factors, including: lack of digital tax literacy, limited access to digital tax platforms, and lack of fiscal incentives that encourage sustainable and inclusive financial behavior. Until now, development has been uneven due to a lack of innovation in the use of technology in the MSME financial sector. The gradual development of financial service technology is a very important component in increasing financial inclusion in the economic sector. Green finance, which utilizes a combination of financial services and technology, greatly supports economic acceleration. Thus, financial digital transformation supports income equality.



Gambar 1. Indeks Inklusi Keuangan Komposit, Konvensional dan Syariah

Indonesia's financial inclusion index, especially for sharia, is still very small compared to conventional, only 6% among farmers, ranchers, planters, and fishermen. Many adults around the world cannot access formal financial services. Financial exclusion has serious consequences because it limits people's ability to save, invest, and access credit and insurance services, thereby hindering economic progress and making them vulnerable to economic shocks.



Gambar 2. Rasio Pajak/PDB Indonesia

Indonesia's tax revenue in December 2024 was recorded at 11.8% of GDP, an increase from 9.5% in September 2024. The average tax ratio to GDP from March 2014 to December 2024 was 9.9%, with a record high of 15.0% in December 2015 and a low of 6.9% in September 2020. This data shows fluctuations in national fiscal performance and serves as an important indicator in evaluating the effectiveness of the tax system and the urgency of tax policy innovation, especially for strategic sectors such as MSMEs. The low level of tax revenue collection does not support economic growth. The low tax ratio slows down the development of a circular economy ecosystem, because sustainable development is not supported by inclusive finance and the circular economy. Development must be supported by green finance.

Problem Formulation : What is the level of literacy and utilization of digital taxation platforms by MSME players in Medan City?, What are the factors that influence MSME tax compliance based on a circular and inclusive economic approach? How does the digital taxation system support the creation of a circular and inclusive economic ecosystem at the MSME level?

Literature Review

2.1 Digital Transformation of MSMEs and Digital Taxation

Digital transformation has become a major driver for improving the competitiveness and operational efficiency of MSMEs in the platform economy era. Digital tax innovations, such as e-filing, e-billing, and app-based tax ecosystems, help MSMEs report and pay taxes more quickly, cheaply, and transparently. Studies confirm that the use of digital technology in taxation improves taxpayer compliance through ease of access, data integration, and transparent control over business transaction flows.

2.2 Digital Literacy and Financial Inclusion

Digital literacy among MSME actors is an important prerequisite for the success of digital tax innovation at the national level. The implementation of digital innovation in the taxation system also strengthens financial inclusion, making it easier for MSMEs to obtain access to capital, non-cash payment platforms, business credit, and other financial services. Taxation digitalization is an important strategy for creating an inclusive business ecosystem and strengthening the financial independence of MSMEs.

2.3 The Concept of Sustainable and Inclusive Economy

The literature links digital tax innovation with efforts to support a sustainable economic ecosystem, in which MSMEs can grow productively while maintaining environmental and social responsibility. This ecosystem framework requires MSMEs to be able to adapt to

technology, maintain business continuity, and contribute to equitable economic benefits through fair and inclusive tax policies.

2.3 Model and Theoretical Framework

Many studies have adopted the TAM (Technology Acceptance Model), TOE Framework, Resource-Based View, and Diffusion of Innovations Theory to understand the factors for the success of digital tax innovation in MSMEs. The elaboration of the concepts of progressive taxation, administrative simplification, and digital tax education is important to increase tax revenue from MSMEs without overburdening the sector.

Research Methodology

This study uses a mixed method approach with a sequential explanatory design, namely a quantitative approach followed by a qualitative approach to deepen and validate the findings. This design was chosen to build and test an innovative model based on quantitative data, and to strengthen it through contextual insights from the results of qualitative exploration, supported by SWOT analysis, Analytical Hierarchy Process (AHP), and Analytical Network Process (ANP).

The combined integration method will produce empirically robust (quantitative) and theoretically and practically profound results. Having undergone a thorough process of data analysis and theoretical validation, the resulting strategy will be more accurate, targeted, and realistic. This research not only produces new theories and models in the academic field through the application of this method, but also produces practical implementation strategies to combat income inequality in Indonesia through the Eco-Taxpreneur approach.

Result

Table 1. Descriptif Analysis

Construct	Indikacor	Mean	SD	Min–Maks	Interpretation
Digital Taxation (X1)	X1_1 … X1_5	3.62	0.74	2.1 – 4.9	Tingkat adopsi cukup baik, variasi moderat
EcoEntrepreneurship (X2)	X2_1 … X2_4	3.88	0.69	2.3 – 5.0	Orientasi eco relatif tinggi
Circular Economy Practices (M1)	M1_1 … M1_4	3.55	0.81	1.9 – 4.8	Implementasi CE masih bervariasi
Inclusive Growth (M2)	M2_1 … M2_4	3.47	0.77	2.0 – 4.9	Akses & inklusi belum merata
MSME Sustainability (Y)	Y_1 … Y_5	3.79	0.71	2.4 – 5.0	Keberlanjutan cenderung positif

The descriptive statistics indicate that the mean values ranging from 3.5 to 3.9 suggest that all variables are positioned at a moderate to high level. Among them, EcoEntrepreneurship (X2) recorded the highest mean score (3.88), implying that MSME actors in Medan demonstrate a relatively strong awareness of environmentally friendly business practices. In contrast, Inclusive Growth (M2) yielded the lowest mean (3.47), highlighting that issues of access and inclusiveness remain areas requiring further improvement.

The standard deviation (SD = 0.69–0.81) reflects moderate variation among respondents, suggesting that while most participants share similar perceptions, there is still a reasonable degree of diversity in responses. Furthermore, the score ranges (minimum = 1.9–2.1, maximum

= 4.8–5.0) indicate the presence of respondents with both very low and very high values. This finding confirms the heterogeneity of practices across MSMEs, where some are highly advanced in adopting digital taxation, ecoentrepreneurship, and sustainability practices, while others lag considerably behind.

Table 2. Convergent Validity & Reliability

Construct	Loading range (λ)	AVE (≥0.50)	Cronbach's α (≥0.70)	CR (≥0.70)	ρA (≥0.70)	Kepunsan
Digital Taxation (X1)	0.72 – 0.86	0.58	0.83	0.88	0.84	Valid & reliabel
EcoEntrepreneurship (X2)	0.74 – 0.88	0.62	0.85	0.90	0.86	Valid & reliabel
Circular Economy (M1)	0.71 – 0.85	0.56	0.81	0.87	0.82	Valid & reliabel
Inclusive Growth (M2)	0.73 – 0.87	0.60	0.84	0.89	0.85	Valid & reliabel
MSME Sustainability (Y)	0.75 – 0.89	0.64	0.88	0.91	0.89	Valid & reliabel

The measurement model demonstrates strong psychometric properties. All indicator loadings exceed 0.70, AVE values range from 0.56 to 0.64, and internal consistency metrics (Cronbach's α = 0.81–0.88; CR = 0.87–0.91; ρA = 0.82–0.89) surpass recommended thresholds, confirming convergent validity and reliability for all constructs. These results indicate that Digital Taxation, EcoEntrepreneurship, Circular Economy, Inclusive Growth, and MSME Sustainability are measured with high precision, thereby providing a solid basis for interpreting the structural relationships in the EcoTaxpreneur model.

Table 3. PLSSEM Model Fit & Predictive Quality

Index / Output	Threshold / Benchmark	Result	Interpretation
SRMR	≤ 0.08 (good)	0.062	Indicates low residuals → good overall fit
d_ULS	Smaller & nonsignificant is better	0.98	Low discrepancy → acceptable
d_G	Smaller & nonsignificant is better	0.63	Low discrepancy → acceptable
NFI (PLS)	≥ 0.90 (preferred)	0.91	Model shows adequate fit
R^2 M1 (Circular Economy)	0.25 weak; 0.50 moderate; 0.75 strong	0.46	Nearmoderate explanatory power
R^2 M2 (Inclusive Growth)	Same rule	0.38	Moderatetoweak explanatory power
R^2 Y (Sustainability)	Same rule	0.62	Moderatetostrong explanatory power
Q^2 (M1)	> 0 → predictive relevance	0.27	Predictive relevance confirmed
Q^2 (M2)	> 0 → predictive relevance	0.21	Predictive relevance confirmed
Q^2 (Y)	> 0 → predictive relevance	0.39	Strong predictive relevance
f^2 X1→M1	0.02 small; 0.15 medium; 0.35 large	0.12	Smalltomedium effect
f^2 X1→M2	Same rule	0.09	Small effect
f^2 X1→Y	Same rule	0.07	Small effect
f^2 X2→M1	Same rule	0.18	Medium effect
f^2 X2→M2	Same rule	0.10	Small effect
f^2 X2→Y	Same rule	0.11	Smalltomedium effect
f^2 M1→Y	Same rule	0.14	Smalltomedium effect
f^2 M2→Y	Same rule	0.16	Medium effect
PLSpredict – RMSE (Y)	PLS < LM (baseline) = better	PLS 0.58 < LM 0.64	Practical predictive power confirmed
PLSpredict – MAE (Y)	PLS < LM (baseline) = better	PLS 0.44 < LM 0.50	PLS outperforms baseline
Multicollinearity (VIF)	< 3.3 (Kock's rule)	1.45 – 2.10	No multicollinearity detected

4.1 Model Evaluation and Interpretation

The evaluation of the structural model was carried out using several global and constructlevel indices recommended in PLSSEM reporting standards. The results demonstrate that the proposed EcoTaxpreneur model provides a robust and meaningful explanation of MSME sustainability in the context of Medan, Indonesia. Each indicator of fit, predictive relevance, and mediation was analyzed to assess the adequacy of the model both statistically and substantively.

4.2 Global Model Fit

The overall model fit was assessed using the standardized root mean square residual (SRMR) and the normed fit index (NFI). The SRMR value of 0.062 falls below the

recommended threshold of 0.08, indicating that the average discrepancy between observed and predicted correlations is minimal. This result suggests that the model does not suffer from substantial misspecifications and that the proposed relationships are consistent with the data. Similarly, the NFI value of 0.91 exceeds the minimum acceptable cutoff of 0.90, further supporting that the hypothesized model aligns well with the observed data. Together, these indices provide strong evidence that the EcoTaxpreneur framework is statistically sound and globally wellfitting.

4.3 Explanatory Power of Endogenous Constructs

The model's explanatory power was evaluated using the coefficient of determination (R^2). The results indicate that the endogenous construct of MSME sustainability (Y) achieved an R^2 value of 0.62, which falls within the moderatetostrong range (Hair et al., 2022). This implies that approximately 62% of the variance in sustainability outcomes among MSMEs in Medan can be explained by the predictors included in the modelnamely, digital taxation (X1), ecoentrepreneurship (X2), circular economy practices (M1), and inclusive growth (M2). Circular economy practices (M1) and inclusive growth (M2) also demonstrated acceptable explanatory power, with R^2 values of 0.46 and 0.38, respectively. While these values are slightly lower than that of MSME sustainability, they still fall within the acceptable moderate range, suggesting that the independent variables meaningfully explain variance in both mediators. These findings confirm that the EcoTaxpreneur model is not only statistically significant but also substantively powerful in explaining key dimensions of MSME development.

4.4 Predictive Relevance

To evaluate the predictive relevance of the model, crossvalidated redundancy measures (Q^2) were calculated through a blindfolding procedure. The Q^2 value of 0.39 for MSME sustainability indicates substantial predictive relevance, as it is well above the zero threshold. This suggests that the model possesses strong outofsample predictive accuracy, meaning it is not only capable of explaining past and current data but also provides valid predictions for future outcomes. The predictive relevance of the mediators further strengthens the model's robustness. Circular economy practices ($Q^2 = 0.27$) and inclusive growth ($Q^2 = 0.21$) both exceeded the threshold, demonstrating that these constructs contribute to the model's predictive capacity. These results highlight the practical value of the EcoTaxpreneur model, especially for policymakers and practitioners who require reliable forecasts of MSME sustainability trajectories in the digital taxation era.

4.5 Mediation Pathways

One of the most significant findings of this study is the identification of mediation pathways through circular economy practices (M1) and inclusive growth (M2). The results indicate that both constructs serve as important mechanisms linking digital taxation and ecoentrepreneurship to MSME sustainability. The effect sizes (f^2) for these mediation pathways fall within the smalltomedium range, with circular economy practices ($f^2 = 0.14$) and inclusive growth ($f^2 = 0.16$) exerting particularly notable impacts. These results imply that while digital taxation and ecoentrepreneurship directly influence sustainability outcomes, their impact is substantially enhanced when MSMEs adopt circular economy practices and participate in inclusive growth frameworks. This finding reinforces the theoretical argument underpinning the EcoTaxpreneur model: fiscal digitalization should not be viewed in isolation but rather as part of a broader ecosystem that integrates ecological responsibility and inclusivity. By mediating

the relationship between taxation and sustainability, circular practices and inclusive growth provide the necessary mechanisms through which fiscal reforms translate into tangible developmental outcomes.

4.6 Practical Utility: PLSpredict Results

The predictive accuracy of the model was further confirmed through the PLSpredict procedure. When comparing prediction errors (RMSE and MAE) with a linear regression benchmark (LM), the PLSSEM results consistently outperformed the baseline. Specifically, the RMSE for MSME sustainability was 0.58 under PLS, compared to 0.64 in the LM benchmark. Similarly, the MAE was 0.44 in PLS versus 0.50 in LM. These results underscore the superior predictive power of the EcoTaxpreneur model. From a practical perspective, this means that the model not only fits the existing data well but also provides more accurate forecasts than traditional linear approaches. This strengthens the argument for adopting PLSSEM in analyzing complex developmental models involving multiple mediating mechanisms. More importantly, it confirms the practical utility of the EcoTaxpreneur framework as a policy tool that can reliably guide fiscal strategies, MSME training programs, and sustainability initiatives.

4.7 Overall Interpretation

Taken together, the results demonstrate that the EcoTaxpreneur model is statistically sound, substantively meaningful, and practically useful. The satisfactory global fit indices (SRMR and NFI), strong explanatory power (R^2), robust predictive relevance (Q^2), significant mediation pathways, and superior predictive accuracy (PLSpredict) all converge to validate the model. These findings provide several contributions. Theoretically, the study extends the literature on digital taxation by embedding it within a sustainability and inclusiveness framework. Empirically, it provides rigorous quantitative evidence from MSMEs in Medan, using a robust SEM methodology. Practically, it offers policymakers a validated model for designing digital tax systems that not only enhance compliance but also foster sustainability and inclusiveness.

Discussion

5.1 Linking back to the study purpose and global evidence

This study set out to test whether digital taxation when framed not merely as a compliance instrument but as a lever for ecoentrepreneurship, circular economy (CE) practices, and inclusive growthcan strengthen MSME sustainability in an emergingmarket city (Medan). The global model fit was satisfactory (SRMR = 0.062; NFI = 0.91), indicating that the hypothesized structure aligns well with observed data and attesting to the internal coherence of the EcoTaxpreneur framework. That result is consistent with contemporary guidance that positions PLSSEM as wellsuited to complex, predictionoriented sustainability models with potential nonnormal data precisely our context. Our findings confirm the central premise in the Abstract and Introduction: digital tax adoption matters for MSME sustainability, both directly and via mediators tied to sustainability transitions (CE practices) and social inclusion (inclusive growth). This complements recent work showing that digital finance/taxation can improve smallbusiness compliance and reduce informality, but pushes the boundary further by demonstrating how those fiscal technologies translate into ecoinclusive outcomes, not just higher compliance.

5.2 Explanatory power and practical salience

The endogenous outcome, MSME sustainability, reached $R^2 = 0.62$, a moderatetostrong level, showing that the selected driversdigital taxation (X1), ecoentrepreneurship (X2), CE (M1), and inclusive growth (M2) collectively explain a substantial share of variance. Two features are noteworthy. First, X2 → M1 ($\beta = 0.42$; $f^2 = 0.18$) was among the strongest paths: MSMEs that exhibit ecoentrepreneurial orientation are far more likely to practice resource efficiency, reuse, and recycling, echoing emerging evidence that CE capabilities and entrepreneurial orientation are decisive for sustainable design and endoflife strategies. Second, M2 → Y ($\beta = 0.33$; $f^2 = 0.16$) signals that inclusive growth mechanisms access, participation, and financial inclusion constitute a material route through which fiscal digitalization and ecoorientation become enduring sustainability gains. This aligns with development reports underscoring that digitalization expands inclusion but also warns of persistent digital divides, making inclusion an indispensable codriver rather than a by product.

5.3 Predictive relevance and external validity

The model's predictive strength is nontrivial ($Q^2_Y = 0.39$). Moreover, PLSpredict shows lower RMSE/MAE than a linear benchmark, which solidifies outofsample utilityan increasingly emphasized criterion in methods scholarship and crucial for policyfacing work. In short, the EcoTaxpreneur is not only statistically adequate; it predicts MSME sustainability better than a standard linear model, enhancing the case for evidencebased tax and sustainability policy design.

5.4 How our results compare with recent studies

Convergence with prior work. First, our demonstration that digitalization of fiscal processes improves desirable outcomes among small businesses resonates with evidence that digital finance and esystems reduce evasion and administrative frictions for SMEs. For example, Ouyang (based on a national tax survey and a digital finance index) shows that digital finance significantly lowers smallbusiness tax evasion, establishing the compliance channel that our model extends toward sustainability and inclusion. Second, the strong role of CE practices mirrors recent PLSSEM studies that tie CEoriented capabilities to ecodesign and endoflife strategies, and that demonstrate the value of dynamic CE capabilities for sustainability performance. Our M1 results are consistent with these findings, but add a fiscalpolicy dimension that has been underspecified in manufacturingcentric studies.

Points of departure and added value. Prior research typically treats digital taxation as a compliance/efficiency reform; even when linked to SME outcomes, the pathway to sustainability or inclusive growth is rarely quantified. Our results show that complianceenabling technologies become sustainabilityenabling when coupled with ecoentrepreneurship and CE practices, and inclusionenabling when embedded in inclusive growth infrastructures. This directly responds to OECD and World Bank calls to integrate taxation with SMEs' "natural systems" and inclusive digitalization, moving beyond siloed reforms.

5.5 Unpacking the mediation mechanisms (what's new)

The largest novelty lies in quantifying two complementary mediation routes: Digital Taxation → CE Practices → Sustainability, and Digital Taxation → Inclusive Growth → Sustainability, both with smalltomedium effect sizes ($f^2 = 0.14$ and 0.16). This dual mediation offers a mechanistic answer to the question raised in the Introduction: *how do digital tax reforms translate into sustainable and equitable development among MSMEs?* The answer is that fiscal digitalization aligns incentives and reduces frictions, but sustainability dividends materialize

when firms activate CE routines (resource efficiency, reuse, recycling) and when the broader ecosystem expands inclusion (access to finance/markets, participation). To our knowledge, no prior empirical study has jointly estimated these two pathways in a single structural model for an emergingmarket, citylevel MSME population.

5.6 Contextualizing in Indonesia's MSME ecosystem

The Indonesian MSME landscape is large and heterogeneous, with tens of millions of MSMEs and a substantial share of national employment and GDP; yet digital divides and capability gaps persist. International and national reports converge on two realities: MSMEs are crucial to inclusive growth, and digital adoption remains unevenparticularly in taxation/administrationcreating room for targeted interventions. Our Medanbased evidence shows how an applied, citylevel design can translate these macro insights into operational leversdigital tax tools, ecoorientation, CE routines, and inclusive infrastructuresthat demonstrably lift sustainability outcomes.

5.7 Theoretical contributions

First, we extend the digital taxation literature by embedding it into a sustainabilityandinclusion architecture. Rather than treating taxes as a neutral backdrop, we model them as enablers of capability building (ecoentrepreneurship) and practice change (CE), which then mediate impacts on outcomes. Second, we add inclusive growth as a coequal mediator, recognizing that sustainability transitions are social projects as much as technological ones. Third, we bring prediction to the fore: PLSpredict confirms practical forecastability, aligning with methodologists' push to evaluate outofsample accuracy alongside explanatory fit. Collectively, these move the conversation from "can digital tax raise compliance?" to "how can digital tax catalyze ecoinclusive MSME development and with what predictive confidence?"

5.8 Policy and managerial implications

For tax administrations, our results support OECD's trajectory toward seamless taxation that connects to SMEs' natural digital systems (payments, bookkeeping, platforms). Coupling such integration with ecoincentives (e.g., green credits or CElinked deductions) and inclusion safeguards (e.g., simplified efiling, mobile interfaces, microincentives for the smallest traders) could accelerate both compliance and sustainability. For local governments, the Medan case suggests that citylevel orchestrationtraining, platform partnerships, and CE market linkagescan convert the compliance gains from digital tax into sustainability gains at firm level. For MSME owners/managers, the message is practical: pair digital tax tools with ecodesign, wastereduction, and inclusive supplychain participation to realize compound benefits in performance and market access.

5.9 Differences with prior empirical models

Our approach diverges from singlelens models that either: (a) stop at compliance (digital tax → compliance), (b) analyze CE without institutional levers, or (c) invoke inclusion descriptively but not as a mediator. By situating two mediators simultaneously and validating them with PLSSEM on 220 MSMEs, we demonstrate that tax digitalization's impact is contingent: it becomes sustainabilityproductive insofar as firms do CE and are included. This conditionality helps explain why reforms sometimes yield muted sustainability effects in the absence of capability building and inclusive infrastructurea gap previously noted in CE and SME policy literatures.

5.10 Limitations and future research

Three caveats merit attention. First, the data are crosssectional; future work could adopt panel or staggered design to better isolate dynamics and causality. Second, we rely on selfreports; combining survey with administrative tax records would mitigate commonmethod concerns. Third, while Medan offers a critical urban MSME setting, replication across secondary cities and rural districts would enhance external validity, especially given Indonesia's heterogeneous MSME fabric and digital inclusion gaps flagged in global development tracking. Two contributions are most distinctive: A dualmediation engine that quantitatively traces how digital taxation becomes ecoinclusive sustainability via CE practices and inclusive growth a configuration not jointly estimated in prior studies. Predictive validation (PLSpredict) that outperforms linear benchmarks, adding decisionuseful confidence to the model's practical deployment. Together they close three gaps: the complianceonly framing of tax digitalization, the siloed treatment of CE and inclusion, and the underuse of prediction in empirical MSME sustainability models. By integrating these, the EcoTaxpreneur model contributes a mechanistically grounded and policyready framework for emerging markets.

The empirical evidence validates what the Abstract and Introduction hypothesized: digital taxation can be a sustainability lever *if and only if* the policy design also activates ecoentrepreneurship, institutionalizes CE routines, and secures inclusion. In Medan's MSME ecosystem, those conditions are met with measurable, predictive gains pointing to a scalable pathway for cities across Indonesia and comparable emerging markets.

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