Digital Pathways to tax compliance: Evidence from the self-employed

by *Zivar Zeynalova*[*], *Natavan Namazova*[**], Gunay Musayeva[***]

Abstract
This study examines digital factors affecting voluntary tax compliance among self-employed in Azerbaijan, an emerging economy undergoing rapid fiscal digitalization. Using Transaction Cost Theory, Technology Acceptance Model, and Behavioral Economics, an integrated model linking corporate digitalization, personalized notifications, and secure digital infrastructure is developed. Data from a 2024 survey of 410 taxpayers is analyzed via two-stage PLS-SEM. Results confirm all three factors significantly improve compliance, with personalized notifications having the strongest effect. The study highlights digital trust and suggests a compliance-by-design approach for fiscal sustainability.
Keywords: Tax compliance, corporate digitalization, personalized notifications, secure digital infrastructure, PLS-SEM.

First submission: 22 October 2025; *accepted*: 19 December 2025;
Online first: 30 December 2025

1. Introduction

Tax compliance is essential for fiscal sustainability as it secures revenue, reduces external debt reliance, and promotes fair tax burden distribution. Governments enhance compliance by lowering administrative costs, simplifying filing, and ensuring transparent policies. The global spread of digital tax tools like e-invoicing, e-ledgers, e-filing, and online payments

[*] Department of State Regulation of the Economy, Academy of Public Administration under the President of the Republic of Azerbaijan, e-mail: zivar.zeynalova@dia.edu.az. Digital economy and financial technologies Department, Azerbaijan Technical University, e-mail: zivar.zeynalova@aztu.edu.az.
[**] Mingachevir State University, e-mail: natavan.namazova@mdu.edu.az. Centre for Studies on European Economy (AIM), Azerbaijan State University of Economics (UNEC), e-mail: natavan.namazova@unec.edu.az.
[***] Digital economy and financial technologies Department, Azerbaijan Technical University, e-mail: gunay.musayeva@aztu.edu.az.

Rivista di Studi sulla Sostenibilità - Open access (ISSNe 2239-7221), 2025

Doi: 10.3280/riss2025oa21321

reduces costs, improves accuracy, and builds trust (OECD, 2022; Bellon et al., 2023). Personalized communication, such as SMS, email, or reminders, nudges timely filing (De Neve et al., 2021). Secure digital infrastructure is vital for confidence, data privacy, and system availability (Schaupp et al., 2010; Mascagni et al., 2021).

In Azerbaijan, digital tax reform has accelerated, but self-employed face information gaps, limited skills, and distrust, hindering compliance.

This study examines how corporate digitalization, personalized notifications, and secure infrastructure affect self-employed taxpayers' compliance. Objectives include:

(i) assessing digital tools' impact on tax reporting accuracy;
(ii) evaluating personalized notifications' effectiveness;
(iii) examining secure infrastructure's role in trust and usage;
(iv) testing these relations via PLS-SEM.

Corporate digitalization aids tracking informal economy, lowers costs, and reduces information gaps. Personalized notifications reduce delays and unintentional non-filing via timely reminders (OECD, 2021). Strong digital security is essential to maintain trust, preventing loss from breaches or downtime. Together, these pillars – digitalization, notifications, and secure infrastructure – are key for sustainable digital tax management and improving self-employed compliance.

2. Literature Review and Hypothesis Development

2.1. Tax Compliance

Tax compliance is a cornerstone of modern fiscal systems, crucial for budget stability, public service funding, and macroeconomic resilience. It shapes economic behavior, builds social trust, and defines state-citizen relations.

Globalization, digitalization, and cross-border trade challenge traditional tax administration, highlighting the need to reduce informal economy, improve risk-based audits, and boost voluntary compliance. Non-compliance reduces revenue and increases inequality, while higher compliance supports fiscal stability, public investment, and tax fairness.

Digital tax tools like e-invoicing, online filing, automated payments, and personalized reminders ease administration, improve accuracy, transparency, and encourage compliance. OECD (2025) reports 85% of authorities use advanced tech for data monitoring, 94% have cybersecurity

units, and 17% use AI in tax processes, showing a global move to digital compliance.

2.2. Theoretical Framework

2.2.1. Transaction Cost Theory

Transaction Cost Theory shows that economic exchange costs exceed production expenses. In taxation, high compliance costs – like complex filing, info access difficulties, and excess paperwork – discourage accurate, timely returns. Digital tools – e-filing, pre-filled forms, e-invoices/ledgers, automated reminders – reduce these costs and boost voluntary compliance (Kochanova et.al., 2016).

Evidence supports this: Brazil's e-invoicing increased receipt demand and supply chain compliance (Naritomi, 2019); Chile and Ecuador saw improved VAT returns with e-invoice reconciliation (Pomeranz, 2015; Carrillo et al. 2017). Bellon et al. (2022, 2023) and CIAT report Latin America's e-invoicing cut costs, enhanced transparency, and fostered compliance. The EU's ViDA initiative plans phased mandatory e-invoicing and real-time reporting (2025-2035).

These findings support H1 – corporate digitalization improves compliance by lowering transaction costs – and indirectly support H2 – automated notifications ease administration and improve timely filing.

2.2.2 Technology Acceptance Model (TAM/UTAUT)

The digitalization of public finance makes electronic tax filing essential for authorities and taxpayers. The Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT) explain adoption of tools like e-filing, e-invoicing, and mobile tax apps. TAM (Davis, 1989) argues adoption depends on Perceived Usefulness (PU) – belief the system improves performance—and Perceived Ease of Use (PEOU) – belief it's easy to use. These shape intention and actual use. UTAUT (Venkatesh et al., 2003) expands TAM with four factors: performance expectancy, effort expectancy, social influence, and facilitating conditions, moderated by age, gender, experience, and voluntariness.

In tax compliance, PU and performance expectancy mean belief in reduced costs and errors; PEOU and effort expectancy reflect usability and support; social influence comes from accountants or authorities; facilitating conditions involve secure infrastructure and training. Research highlights trust and data security's importance: Schaupp et al. (2010) show trust aids e-

filing in the US; OECD (2025) notes cybersecurity as key; Bélanger and Carter (2008) warn privacy fears deter use. TAM and UTAUT thus support H1-H3, linking digital design, user experience, and security to better compliance.

2.2.3 Behavioral Economics and Nudge Theory

Behavioral economics shows that decisions are influenced by bounded rationality, biases, social norms, and trust (Kahneman and Tversky, 1979), offering more realistic policy tools than purely punitive models. Nudge Theory (Thaler and Sunstein, 2008) applies behavioral economics by designing subtle interventions – pre-filled forms, reminders, default payments – that guide compliance without coercion, reducing procrastination and costs. Hallsworth et al. (2017) found social-norm messages raised UK taxpayer compliance by 5-15%. Kogler, Muehlbacher, and Kirchler (2015) linked simpler procedures and fairness perceptions to higher compliance via trust. OECD (2019) reported SMS nudges lowered costs and increased filings in multiple countries.

These behaviorally informed tools improve voluntary compliance by reducing transaction costs and boosting trust, often more cost-effective than deterrence. In this study, these insights support H2 (personalized notifications as nudges) and H3 (trust through secure infrastructure), highlighting psychological mechanisms behind user experience and compliance. Overall, effective digital tax compliance relies on three pillars: lowering transaction costs (corporate digitalization), enabling adoption (technology acceptance), and reinforcing trust and timely action (behavioral nudges), underpinning hypotheses H1-H3.

2.3. Research Questions and Hypotheses

This study examines how digital factors influence tax compliance among self-employed taxpayers in Azerbaijan, a group facing information gaps and low digital literacy. Using transaction cost theory, the technology acceptance model, and behavioral economics, it fills a research gap on digital tax tools' impact in Azerbaijan, especially for the self-employed. Research questions:

1. How do corporate digitalization practices (e-invoicing, e-filing, online payments, digital auditing) affect compliance?
2. What impact do personalized notifications (SMS, email reminders) have on timely tax payments?
3. How do digital infrastructure's reliability and security affect compliance?

4. Which factor – digitalization, notifications, or infrastructure security—most strongly influences compliance?
5. What policy recommendations emerge to improve Azerbaijan's digital tax system?

The study proposes hypotheses based on these core digital transformation dimensions.

H1: Corporate digitalization practices have a positive and statistically significant effect on tax compliance among self-employed individuals.

H2: Personalized notification mechanisms positively influence the timeliness of fulfilling tax obligations.

H3: Ensuring robust security and reliability standards in digital infrastructure exerts a positive effect on tax compliance among self-employed individuals.

Together, these questions and hypotheses establish the analytical framework for assessing how different digital pathways – technological, behavioral, and infrastructural – interact to promote tax compliance in the context of an emerging economy.

3. Digitalization and Self-Employment in Azerbaijan

Over the past decade Azerbaijan has rapidly digitalised its tax administration, introducing e-filing, online-payment portals, e-invoicing platforms and digital-audit tools supported by the ASAN e-ID system. These reforms lowered administrative burdens – required tax payments fell from 18 to 9 and compliance time dropped by > 40 % (World Bank, 2020) – yet informality persists: self-employed workers represent 67.6 % of total employment (CEIC, 2023) and only 32 % of employees held formal labour contracts in 2019 (ETF, 2021). Such conditions – information gaps, limited digital literacy and uneven institutional trust – make the self-employed a priority group for understanding how digital-tax reforms affect voluntary compliance.

Digital services now provide direct online channels for income declaration and, when paired with risk-profiling and e-audit functions, improve detection of reporting irregularities. Although personalised reminders (SMS / e-mail) are not yet widely deployed, the ASAN-Signature infrastructure already enables secure communication and could support future reminder-based interventions. High mobile-phone penetration suggests these nudges could become a cost-effective way to improve the timeliness of payments, warranting further empirical testing.

Progress in national e-governance performance – the UN-EGDI score rose from 0.45 (2010) to 0.71 (2020) (OECD, 2022; PwC, 2025; EY, 2025; Deloitte, 2023) – underlines the stronger institutional and technological base now available for embedding corporate digitalisation, personalised notifications and secure infrastructure in Azerbaijan's tax-compliance system.

4. Materials and Methods

4.1 Research Design

This study uses a quantitative approach to examine how corporate digitalization, personalized notifications, and secure digital infrastructure affect tax compliance among self-employed individuals in Azerbaijan. Structural equation modeling (SEM) within a predictive-exploratory framework tests the hypotheses. Data were collected from March to May 2024.

The quantitative method allows hypothesis testing with measurable indicators and statistically robust analysis of relationships between latent variables. SEM enables simultaneous evaluation of the measurement model (linking indicators to latent variables) and the structural model (linking latent variables), providing insight into causal factors influencing voluntary tax compliance in digital contexts.

4.2 Model Specification and Analytical Procedure

A two-stage hierarchical component model (HCM) within the PLS-SEM framework was used to handle reflective first-order constructs and a formative second-order construct (Hair et al., 2019).

- *Stage 1* assessed measurement of the first-order reflective constructs: Corporate Digitalization (CD), Personalized Notifications (PN), and Secure Digital Infrastructure (SDI). Validity criteria included indicator loadings (> 0.70), composite reliability (CR > 0.70), average variance extracted (AVE > 0.50), and discriminant validity (HTMT < 0.85).
- *Stage 2* used latent scores from Stage 1 as formative indicators to estimate the higher-order construct "Digital Pathways to Compliance." This formative model was evaluated through indicator weight significance ($p < 0.05$), collinearity checks (VIF < 3.3), and bootstrapped path coefficients (5,000 resamples).

This two-stage reflective-formative approach ensures clear separation between measurement validity and formative aggregation, preventing misspecification and aligning behavioral, technological, and infrastructural factors in digital tax compliance theory.

4.3 Data Collection Instrument

Data were obtained through a structured questionnaire capturing demographic and behavioral attributes of self-employed taxpayers. The instrument included five sections: demographic characteristics (gender, age, sector), corporate digitalization (e-invoices, e-ledgers, e-declarations, online payments, digital audits), personalized notifications (SMS, email, risk-based reminders), secure digital infrastructure (system speed, accessibility, data privacy, security), and tax compliance (reporting accuracy, payment timeliness). All items were rated on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). The questionnaire combined validated scales with context-specific items reflecting Azerbaijan's institutional environment. Measures of corporate digitalization were adapted from prior studies (Hung, Chang and Yu, 2006; Schaupp, Carter and McBride, 2010; Kirchler, Hölzl and Wahl, 2008; Abdelnabi et al., 2024; Wahl, Kastlunger and Kirchler, 2010). Items on personalized notifications followed behavioral-economics and nudge-theory research (Hallsworth et al., 2017).

4.4 Sample and Data Collection

The survey was conducted online in Azerbaijani between March and May 2024 using a simple random probability sampling method. The sampling frame was based on the official registry of self-employed individuals from professional associations, ensuring equal selection probability and population representativeness. Random numbers were generated in R software to select participants. Participation was voluntary, anonymous, and without replacement for non-responses. A pilot test with 20 respondents confirmed clarity and reliability. The final sample included 410 valid cases, meeting PLS-SEM sample-size requirements. Under Article 13 of the Azerbaijan Tax Code, self-employed refers to individuals operating independently without a legal entity. Respondents represented five sectors: law and finance (21.0%), medicine and health (20.5%), engineering and technical fields (22.9%), education and consultancy (19.8%), and creative and cultural activities (15.8%). The sample comprised 58% males and 42% females; 20.5% aged 18-35, 40.7% aged 35-50, 24.9% aged 50-65, and 13.9% aged 65+.

Table 1 - Demographic Characteristics of the Participants

Variable	Category	N	%
	Male	238	58.0
	Female	172	42.0
Age	18–35	84	20.5
	35–50	167	40.7
	50–65	102	24.9
	65 and above	57	13.9
Sector	Law and Finance	86	21.0
	Medicine and Healthcare	84	20.5
	Engineering and Technical	94	22.9
	Education and Consultancy	81	19.8
	Creative and Cultural Activities	65	15.8
Total		410	100

Structural Equation Modeling was used to assess the validity, reliability, and predictive performance of the proposed model. While covariance-based SEM (e.g., AMOS) is common in confirmatory analysis, this study employed Partial Least Squares SEM (PLS-SEM) as suitable for predictive and exploratory research (Hair et al., 2019). A two-stage analytical procedure was implemented. First, the measurement model was tested for construct validity. Convergent validity was confirmed through factor loadings (> 0.50), composite reliability (CR > 0.70), and average variance extracted (AVE > 0.50). Discriminant validity was verified via HTMT (< 0.85), and internal consistency through CR and AVE thresholds. Multicollinearity was checked using VIF (< 5), and indicator weights were tested via bootstrapping (5,000 subsamples; weight > 0.10, $p < 0.05$). Second, the structural model was evaluated through R^2, Q^2 (blindfolding), and path coefficients with significance levels. Out-of-sample predictive accuracy was verified using the PLS-Predict procedure.

5. Results

The empirical analysis followed the two-stage hierarchical component model (HCM) procedure outlined in Section 4.2. In Stage 1, the reflective measurement models of the three first-order constructs – Corporate Digitalization (CD), Personalized Notifications (PN), and Secure Digital Infrastructure (SDI) – were assessed for reliability and validity. In Stage 2, the latent variable scores from these constructs were used as formative indicators of the higher-order construct *Digital Pathways to Compliance*, and the full structural model was estimated to test hypotheses H1-H3.

5.1. Measurement Model

Convergent validity was examined through factor loadings (> 0.50), composite reliability (CR > 0.70), and average variance extracted (AVE > 0.50). As shown in Figure 1, all indicators loaded satisfactorily on their respective constructs (CD, PN, SDI), with loadings ranging from 0.694 to 0.763. All three constructs met the CR and AVE thresholds, confirming adequate convergent validity and internal consistency. Overall, the measurement model demonstrated satisfactory reliability and validity.

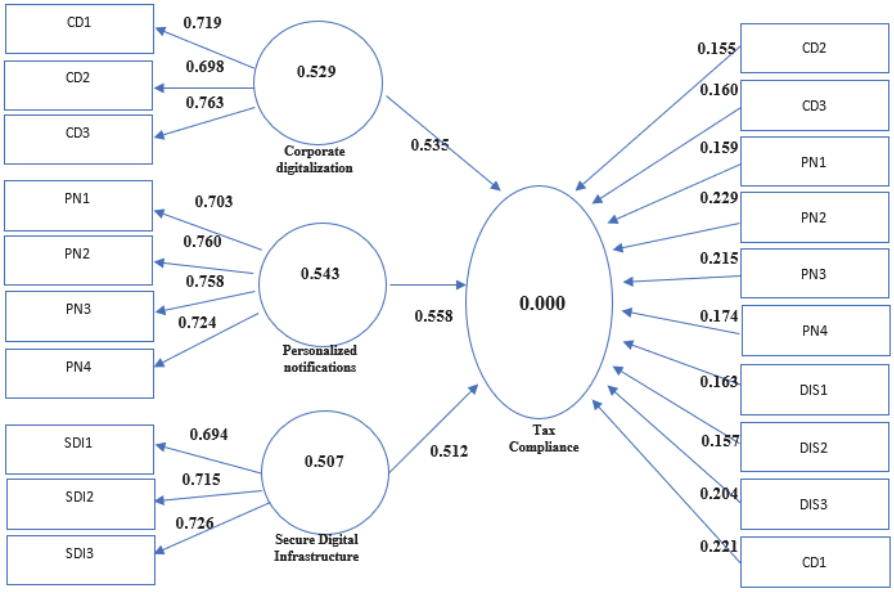

Figure 1 - Outcomes of the measurement model

The factor loadings were evaluated during the validation stage, with all reflective constructs exceeding the 0.60 threshold and individual indicator loadings above 0.50. Two low-performing indicators – CD4 (0.458) and SDI4 (0.469) – were removed due to their insufficient standardized loadings (< 0.55), which affected convergent validity. After refinement, composite reliability (CR) and average variance extracted (AVE) were recalculated (Table 2). The revised results indicate: Corporate Digitalization (CD): CR = 0.771, AVE = 0.529; Personalized Notifications (PN): CR = 0.826, AVE = 0.543; and Secure Digital Infrastructure (SDI): CR = 0.755, AVE = 0.507. All constructs surpassed the recommended thresholds (CR > 0.70; AVE >

0.50), confirming strong internal consistency and convergent validity of the measurement model.

Table 2 - Results of the first-order reflective measurement model

Construct	Items	Loadings	CR	AVE
Corporate digitalization	CD1	0.719	0.771	0.529
	CD2	0.698		
	CD3	0.763		
Personalized notifications	PN1	0.703	0.826	0.543
	PN2	0.760		
	PN3	0.758		
	PN4	0.724		
Secure digital infrastructure	SDI1	0.694	0.755	0.507
	SDI2	0.715		
	SDI3	0.726		

Discriminant validity was assessed using the heterotrait–monotrait (HTMT) criterion, and all HTMT ratios were well below the recommended threshold of 0.90 (Tehseen et al., 2017), thereby confirming satisfactory discriminant validity among the constructs. Bootstrapping analysis was conducted to determine whether the HTMT values significantly differ from 1.00 (Abu, 2021). All HTMT values were found to be significantly below the threshold and statistically different from 1.00.

Table 3 - Assessment of discriminant validity (HTMT) for first-order constructs

Construct	*Relation*	*HTMT*	*p-Value*
Personalized notifications → Corporate digitalization	PN → CD	0.310	0.003
Secure digital infrastructure → Personalized notifications	SDI→ PN	0.104	0.019
Secure digital infrastructure → Corporate digitalization	SDI→ CD	0.429	0.010

5.2. Structural Model

The coefficient of determination (R^2) for Tax Compliance was 0.620, indicating that corporate digitalization, personalized notifications, and secure digital infrastructure together explain 62% of the variance, which reflects substantial explanatory power. The cross-validated redundancy measure ($Q^2 = 0.41 > 0$) further supports the model's predictive relevance (Hair et al., 2019).

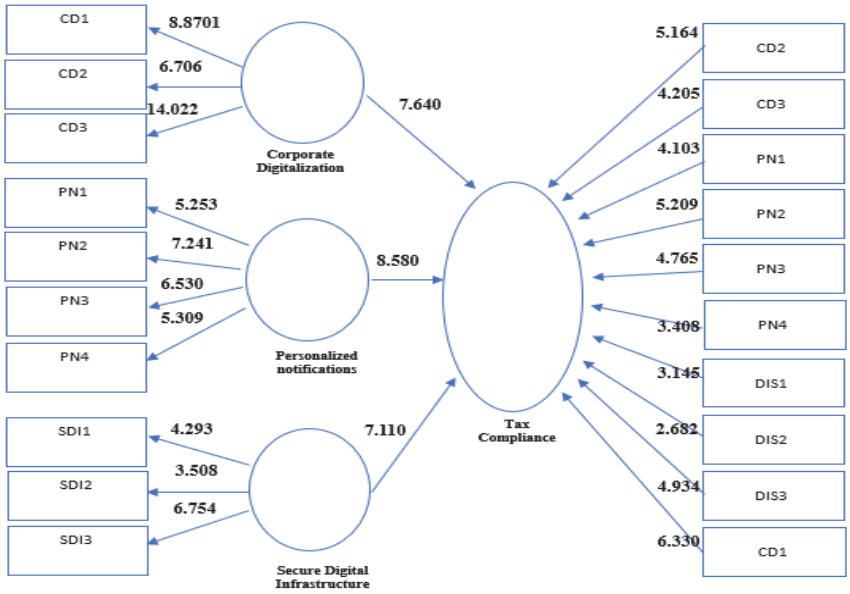

Figure 2 - Bootstrapping results

Figure 2 presents the structural relationships of the model. All indicators loaded significantly on their respective constructs ($t > 1.96$, $p < 0.05$). In the structural model, personalized notifications (PN → Tax Compliance; $t = 8.580$) showed the strongest positive effect, followed by corporate digitalization (CD → Tax Compliance; $t = 7.640$) and secure digital infrastructure (SDI → Tax Compliance; $t = 7.110$). Bias-corrected confidence intervals (CD: 0.351-0.577; PN: 0.490-0.561; SDI: 0.403-0.528) did not include zero, confirming the robustness of the results. Overall, secure digital infrastructure builds taxpayer trust and accessibility, personalized notifications strengthen compliance-oriented behavior, and corporate digitalization reduces administrative burdens – together fostering higher voluntary tax compliance.

Table 4 - Formative higher-order construct evaluation

Construct	**Collinearity (VIF)**	**Outer Weight**	**p-Value**	**95 % Confidence Interval [5 % – 95 %]**
CD	1.114	0.535	< 0.001	[0.351 – 0.577]
PN	1.062	0.558	< 0.001	[0.490 – 0.561]
SDI	1.095	0.512	< 0.001	[0.403 – 0.528]

Table 4 presents the results for the formative higher-order construct. All collinearity values (VIF = 1.062–1.114) were below the conservative threshold of 3.3, confirming the absence of multicollinearity (Kock, 2015). Bias-corrected 5%–95% confidence intervals excluded zero, indicating robust parameter estimates. The Standardized Root Mean Square Residual (SRMR) ranged below 0.08, reflecting a good overall model fit, while the RMSθ value below 0.12 confirmed no significant model misspecification (Huang, 2021). Global fit indices from SmartPLS 4 were satisfactory: SRMR = 0.056 and RMSθ = 0.10. Together, these indicators confirm that the structural model demonstrates strong explanatory power, predictive accuracy, and an acceptable overall fit.

5.3. Direct Path Analysis

The structural model offered strong empirical support for all three hypothesized relationships (H1-H3).

Corporate Digitalization → Tax Compliance
$\beta = 0.535$, $t = 7.640$, $p < 0.001$; 95% CI [0.397-0.623] – indicating that greater adoption of e-filing, e-invoicing, and online-payment platforms significantly enhances voluntary compliance.

Personalized Notifications → Tax Compliance
$\beta = 0.558$, $t = 8.580$, $p < 0.001$; 95% CI [0.424-0.581] – emerged as the strongest behavioral predictor, underscoring the importance of timely, targeted messages such as reminders and risk-based alerts in promoting on-time filing and payment.

Secure Digital Infrastructure → Tax Compliance
$\beta = 0.512$, $t = 7.110$, $p < 0.001$; 95% CI [0.417-0.605] – showing that a secure, reliable, and accessible digital environment fosters taxpayer trust and voluntary compliance.

The results provide compelling evidence in support of H1-H3. While all three drivers positively and significantly influence voluntary tax compliance, personalized notifications (H2) had the largest direct behavioural impact. These findings highlight the synergistic importance of combining digital-transformation initiatives with behaviourally-informed communication strategies to enhance voluntary compliance among self-employed taxpayers.

Table 6 presents a concise synthesis of the study's empirical findings in relation to each research question (RQ1-RQ5).

Table 5 - Direct-Path Coefficients (β), t-values and 95 % Confidence Intervals for H1-H3

H	Relation	Path Co-Efficient (β)	Standard Deviation	*t*-Value	*p*-Value	95 % Confidence Interval [5 % – 95 %]	Results
H1	CD→ TC	0.535	0.070	7.640	< 0.001	[0.397 – 0.623]	Supported
H2	PN→ TC	0.558	0.065	8.580	< 0.001	[0.424 – 0.581]	Supported
H3	SDI→ TC	0.512	0.072	7.110	< 0.001	[0.417 – 0.605]	Supported

Table 6 - Research questions and findings

Research Question	Findings / Answers
RQ1	Corporate digitalization significantly improved reporting accuracy and timeliness (**β = 0.535, p < 0.001**), supporting H1.
RQ2	Personalized notifications had the strongest effect on compliance (**β = 0.558, p < 0.001**), confirming that timely reminders enhance voluntary and on-time compliance.
RQ3	Secure digital infrastructure positively influenced compliance (β = 0.512, p < 0.001).
RQ4	Among the predictors, personalized notifications were the most influential deerminant, followed by corporate digitalization and secure digital infrastructure.
RQ5	The study recommends a "compliance-by-design" approach—expanding digital tools, integrating personalised risk-based communication, and investing in secure digital infrastructures to reduce administrative burdens, foster trust, and enhance efficiency.

This summary highlights how the three key dimensions – corporate digitalization, personalized notifications, and secure digital infrastructure – collectively shaped self-employed taxpayers' compliance behaviour.

6. Discussion

6.1. Corporate Digitalization

This study confirmed that corporate digitalization significantly improves reporting accuracy and timeliness among self-employed taxpayers in Azerbaijan. The results are consistent with findings from Peru (Bellon et al., 2023) and Ethiopia (Mascagni et al., 2021), indicating that automation and secure digital systems promote voluntary compliance in emerging economies. The relatively stronger effect observed in Azerbaijan may be attributed to recent fiscal digitalization reforms and substantial government investments in e-filing, e-payment, and digital audit systems.

6.2. Personalized Notifications

Personalized notifications had the strongest influence on timely compliance (H2). SMS, e-mail, and platform-based reminders effectively reduced late payments, supporting prior experimental findings (Hallsworth et al., 2017). Their effectiveness depends on message framing, trust, and cultural context. In Azerbaijan, high smartphone usage and the reliability of ASAN trust services have amplified the positive impact of personalized reminders. Reforms such as ASAN Service centers and digital ID systems, combined with widespread mobile adoption, have enhanced responsiveness to targeted communications. Consequently, personalized and risk-based reminders outperform generic messages in promoting compliance behavior.

6.3. Secure Digital Infrastructure

Secure digital infrastructure (H3) also emerged as a significant determinant of tax compliance. After refining the indicators, AVE improved to acceptable levels, confirming the construct's validity, though trust-related aspects warrant deeper exploration. Prior research emphasizes that trust, confidentiality, and system reliability are essential for adopting digital tax services (Schaupp et al., 2010; Zhao and Liu, 2019), while technical failures can deter compliance (Bélanger and Carter, 2008). These findings highlight the necessity of maintaining secure, accessible, and stable digital systems to strengthen taxpayer trust and ensure sustained voluntary compliance.

7. Conclusion

7.1. Theoretical Implications

This study advances tax-compliance theory by integrating corporate digitalization, personalized notifications, and secure digital infrastructure into a unified framework. It extends TAM and UTAUT by showing that digital tools – such as e-invoicing, online payments, and digital audits – reduce transaction costs and enhance compliance (supporting H1 and Transaction Cost Theory). It enriches Nudge Theory by demonstrating that personalized and timely reminders outperform generic messages in driving compliance (supporting H2). Finally, it introduces digital trust as a new construct linking secure infrastructure, privacy, and reliability to voluntary compliance (supporting H3). Overall, the study bridges technology adoption, behavioral economics, and institutional trust into a cohesive model of digital tax compliance.

7.2. Practical Implications

The findings provide clear and actionable policy directions for tax administrations in Azerbaijan and other countries undergoing fiscal digitalization. By translating the three empirically validated determinants of compliance – corporate digitalization, personalized notifications, and secure digital infrastructure – into structured strategies, the study offers a roadmap for building a more transparent, efficient, and trust-based tax ecosystem.

Corporate Digitalization (H1): Strengthening Efficiency and Transparency

- Expanding e-invoicing, e-ledgers, and digital audits improves reporting accuracy and lowers admin costs. To fully realize these benefits, tax authorities should adopt a phased, incentive-based, and capacity-focused strategy:
- Phased rollout: Make digital reporting mandatory over two years for entities earning over 20,000 AZN/year.
- Incentives: Offer 5-10% income tax credits or fee waivers for early adopters of certified e-accounting tools.
- Microfinance aid: Provide subsidized POS devices, cloud tools, and vouchers, especially for rural/small businesses.
- Tailored dashboards: Create sector-specific digital interfaces to reduce reporting errors.

- Capacity building: Require 6+ hours of annual e-training linked to license renewal.
- Support services: Set up help desks and on-demand tech support during rollout.

Personalized Notifications (H2): Enhancing Timeliness through Behavioral Nudges

Personalized, data-driven communication is the most effective behavioral lever for improving filing and payment compliance. The integration of behavioral insights into digital messaging can significantly improve responsiveness and trust. Recommended actions include:

- **Message design:** Use concise messages (<120 characters) with clear due dates, secure payment links, and recognizable tax-authority branding.
- **Behavioral A/B testing:** Experiment with alternative message framings to identify which psychological cues (e.g., social norms or loss aversion) work best for different taxpayer groups.
- **Channel segmentation:**
  - *18-35 years:* Mobile-app notifications or WhatsApp/Telegram chatbots.
  - *35-50 years:* Combined SMS and email delivery.
  - *>50 years or rural areas:* SMS complemented by automated voice calls.
- **Risk-based targeting:** Implement automated risk-scoring algorithms that trigger progressive reminder sequences (gentle → urgent → compliance warning).
- **Two-way interaction:** Include "Need Help?" buttons linking users directly to chatbots or call centers for real-time assistance.
- **Inclusivity:** Ensure accessibility by using infographic-based tutorials, bilingual (Azerbaijani-English) messages, and screen-reader-friendly formats for users with limited digital literacy or visual impairments.

Secure Digital Infrastructure (H3): Building Trust and System Resilience

A reliable and secure digital infrastructure is fundamental to sustaining voluntary tax compliance. Ensuring data protection, system stability, and transparency strengthens public trust and supports continuous digital engagement. Key actions:

- Cyber-resilience roadmap: Conduct annual cybersecurity audits and maintain ≥ 99.5% uptime for all core tax services.
- Two-factor authentication (2FA): Require e-ID plus SMS/OTP verification for high-risk transactions.

- Data-privacy certification: Launch a national "TaxData-Secure" label aligned with ISO 27001 and GDPR standards.
- Mobile-first design: Optimize tax platforms for mobile access with offline synchronization in low-connectivity regions.
- Disaster recovery: Perform biannual failover drills and publish readiness results.
- Public-trust dashboard: Share real-time uptime, response, and security metrics to enhance transparency and accountability.
- These measures collectively ensure a security-first, trust-centered digital ecosystem that reinforces compliance and institutional credibility.

7.3. Integrated Compliance-by-Design Approach

These measures collectively emphasize a "compliance-by-design" strategy, embedding secure systems, real-time reporting, and behavioral nudges into tax-platform architecture. Such integration is expected to lower administrative burdens, increase efficiency, and promote cooperative compliance. Key challenges include fiscal constraints, digital inequality, and capacity gaps. Sustainable implementation requires a whole-of-government approach – combining budget commitments, public-awareness campaigns, and partnerships with financial institutions, telecoms, and civil society. Future reforms should merge digital innovation with cost-reduction, inclusivity, and taxpayer-education initiatives to enhance compliance while ensuring fairness and sustainability.

Funding: This research received no external funding.

Ethics, Consent to Participate, and Consent to Publish declarations: The study was conducted in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki, and its later amendments or comparable ethical standards, and approved by the Institutional Review Board (or Ethics Committee) of Economic Think (protocol code 202333 and date of approval 22 December 2023).

Data availability statement: Due to privacy and legal restrictions, the raw survey data cannot be shared publicly. De-identified data and the code used for analysis are available from the corresponding author upon reasonable request.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Conflicts of Interest: The authors declare no conflict of interest.

References

Abdelnabi, M., Wahid, N. A., Mahmood, M., and Kausar, K. (2024). Nudging tax filing through text message combinations: Evidence from Pakistan. *Behavioural Public Policy*, 1-25. Doi: 10.1017/bpp.2024.61.

Abu, F., Gholami, H., Saman, M. Z. M., Zakuan, N., Streimikiene, D., and Bélanger, F., and Carter, L. (2008). Trust and risk in e-government adoption. *Journal of Strategic Information Systems, 17*(2), 165-176.

Bellon, M., Dabla-Norris, E., and Khalid, S. (2023). Technology and tax compliance spillovers: Evidence from a VAT e-invoicing reform in Peru. *Journal of Economic Behavior and Organization*, 212(C), 756-777. Doi: 10.1016/j.jebo.2023.06.004.

Carrillo, P., Pomeranz, D., and Singhal, M. (2017). Dodging the taxman: Firm misreporting and limits to tax enforcement. *American Economic Journal: Applied Economics, 9*(2), 144-164.

CEIC Data (2023). *Azerbaijan: Self-employed (modeled ILO estimate, % of total employment)*. CEIC. -- Retrieved August 25, 2025, from https://www.ceicdata.com/en/azerbaijan/employment-and-unemployment/az-selfemployed-modeled-ilo-estimate--of-total-employment.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319-340.

De Neve, J.-E., Imbert, C., Spinnewijn, J., Tsankova, T., and Luts, M. (2021). How to improve tax compliance? Evidence from population-wide experiments in Belgium. *Journal of Political Economy*, 129(5), 1425-1463.

Deloitte (2023). *Law on changes to the Tax Code of Azerbaijan*. Deloitte Azerbaijan. Retrieved August 25, 2025.

E-Invoicing in Azerbaijan: A 2025 Overview, -- VATUpdate, 2025, https://www.vatupdate.com/2025/05/17/e-invoicing-in-azerbaijan/?utm_source (12.06.2025).

European Commission (2022). *VAT in the Digital Age*, Final Report Volume 1, Digital Reporting Requirements, Directorate-General for Taxation and Customs Union. Retrieved August 13, 2025.

European Training Foundation (2021). New Forms of Employment in the Eastern Partnership Countries: Platform Work – Azerbaijan, Retrieved August 13, 2025, -- from https://www.etf.europa.eu/sites/default/files/2021-06/platform_work_azerbaijan_1.pdf.

EY (2025, April 30). *Azerbaijan to require VAT registration for nonresident entities providing digital services to individuals*. Retrieved August 25, 2025, -- from https://taxnews.ey.com/news/2025-0969-azerbaijan-to-require-vat-registration-for-nonresident-entities-providing-digital-services-to-individuals.

Hallsworth, M., List, J.A., Metcalfe, R.D. and Vlaev, I. (2017). The behavioralist as tax collector: Using natural field experiments to enhance tax compliance. *Journal of Public Economics*, 148(C), 14-31. Doi: 10.1016/j.jpubeco.2017.02.003.

Huang, C.-H. (2021). Using PLS-SEM model to explore the influencing factors of learning satisfaction in blended learning. *Education Sciences*, 11(5), 249. Doi: 10.3390/educsci11050249.

Hung, S. Y., Chang, C. M., and Yu, T. J. (2006). Determinants of user acceptance of the e-Government services: The case of online tax filing and payment system. *Government Information Quarterly, 23*(1), 97-122.

Inter-American Center of Tax Administrations (CIAT) (2025, April 28). *Electronic invoicing: A Latin American innovation with global reach.* CIAT. -- https://www.ciat.org/electronic-invoicing-a-latin-american-innovation-with-global-reach/?lang=en (08.07.2025).

Kahneman, D., and Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica, 47*(2), 263-291.

Kleven, H. J., Knudsen, M. B., Kreiner, C. T., Pedersen, S., and Saez, E. (2011). Unwilling or unable to cheat? Evidence from a randomized tax audit experiment in Denmark. *Econometrica, 79*(3), 651-692.

Kochanova, A. and Hasnain, Z. and Larson, B. (2016). Does E-Government Improve Government Capacity? Evidence from Tax Administration and Public Procurement (April 28,). World Bank Policy Research Working Paper No. 7657, -- Available at SSRN: https://ssrn.com/abstract=2772317.

Kock, N. (2015). Common method bias in PLS-SEM: A full collinearity assessment approach. *International Journal of e-Collaboration*, 11(4), 1-10.

Kogler, C., Muehlbacher, S., and Kirchler, E. (2015). Testing the "slippery slope framework" among self-employed taxpayers. *Economics of Governance, 16*(2), 125-142. Doi: 10.1007/s10101-015-0158-9.

Mascagni, G., Mengistu, A. T., and Woldeyes, F. B. (2021). Can ICTs increase tax compliance? Evidence on taxpayer responses to technological innovation in Ethiopia. *Journal of Economic Behavior and Organization*, 189, 172-193. Doi: 10.1016/j.jebo.2021.06.007.

Naritomi, J. (2019). Consumers as tax auditors. *American Economic Review, 109*(9), 3031-72. Doi: 10.1257/aer.20160658.

OECD (2022). *Promoting Enterprise Digitalisation in Azerbaijan*, OECD Publishing, Paris, Doi: 10.1787/6a612a2a-en.

Organisation for Economic Co-operation and Development (OECD) (2025, June 17). *Tax Administration Digitalisation and Digital Transformation Initiatives***.** OECD Publishing. Doi: 10.1787/c076d776-en.

Ortega, D. and Scartascini, C. (2015). Don't blame the Messenger. A Field Experiment on Delivery Methods for Increasing Tax Compliance. Research Department working papers 821, CAF Development Bank of Latinamerica.

Pomeranz, D. (2015). No taxation without information: Deterrence and self-enforcement in the value added tax. *American Economic Review, 105*(8), 2539-69.

PwC (2025, May 14). *Azerbaijan – New e-registration for non-established providers of digital services*. Retrieved August 15, 2025, -- from https://knowledgenavigator.pwc.com/equity/news/azerbaijan-new-e-registration-for-non-established-providers-of-digital-services/.

SAT Project Team, and BIT Project Team (2019, October). Evaluating the impact of SMS reminders on tax compliance (Final Project Report). Inter-American Development Bank and Behavioural Insights Team. Retrieved August 13, 2025, -- from https://www.bi.team/wp-content/uploads/2019/11/Guatemala-6-TR-Encourage-timely-declaration-of-tax-1.pdf.

Schaupp, L. C., Carter, L., and McBride, M. E. (2010). E-file adoption: A study of U.S. taxpayers' intentions. *Computers in Human Behavior, 26*(4), 636-644.

State Tax Service, -- https://www.taxes.gov.az/en/page/dovlet-vergi-xidmeti (15.03.2025).

Tehseen, S., Sajilan, S., Gadar, K., and Ramayah, T. (2017). Assessing cultural orientation as a reflective-formative second-order construct: A recent PLS-SEM approach. *Review of Integrative Business and Economics Research*, 6, 38-63.

Thaler, R. H., and Sunstein, C. R. (2008). *Nudge: Improving decisions about health, wealth, and happiness.* New Haven, CT: Yale University Press.

Venkatesh, V., Morris, M. G., Davis, G. B., and Davis, F. D. (2003). User acceptance of IT: Toward a unified view. *MIS Quarterly*, 27(3), 425-478. Doi: 10.2307/30036540.

Wahl, I., Kastlunger, B., and Kirchler, E. (2010). Trust in authorities and power to enforce tax compliance: An empirical analysis of the "slippery slope framework." *Law and Policy, 32*(4), 383-406.

World Bank (2020). *Doing Business 2020: Azerbaijan – Paying taxes*. Washington, DC: World Bank Group. Retrieved August 25, 2025, -- from https://www.doingbusiness.org/content/dam/doingBusiness/country/a/azerbaijan/AZE.pdf.

Zhao, L., and Liu, B.-b. (2019, January). Trust-related factors affecting citizens' adoption of e-government based on TAM model. *DEStech Transactions on Social Science, Education and Human Science*.

Appendix 1

Scale Items on Institutional Digitalization Practices	
	Using e-declaration, e-invoice, and e-ledger makes tax filing easier and accounting more transparent.
	Online payment systems (paying taxes via the internet) reduce my transaction costs.
	The use of digital audit systems increases the efficiency of the tax administration.
	Electronic systems reduce errors compared to paper-based reporting.
Scale Items on Personalized Notifications	
	SMS/email reminders from the tax authority reach me at the right time.
	After receiving notifications, my likelihood of delays or mistakes decreases.
	Risk-based notifications have a positive influence on my behavior.
	Notifications clearly state what I need to do (due date, amount, link).
Scale Items on Secure Digital Infrastructure	
	I am more willing to submit declarations online when I am confident that my personal and financial data are protected.
	The tax authority's online systems are fast and accessible, which makes it easier for me to comply with tax obligations.
	Strong security measures in digital platforms increase my trust in using e-tax services.
	Knowing that the system has strong backup and recovery mechanisms reassures me to comply digitally.
Scale Items on Tax Compliance	
	I submit my tax returns on time.
	My tax returns are accurate and reflect the true situation.
	I pay my taxes on time.
	I make voluntary corrections when necessary.