



Impact of Technology on Tax Revenue in Transitional Markets. How Relevant is Financial Development?

Kunofiwa Tsaurai¹

Abstract; Objectives: This study examined the role of technology in tax revenue collection in transitional markets. Using the same set of data, it also explored if financial development is a channel through which technology enhanced tax revenue in transitional markets. **Prior Work:** Both theoretical and empirical literature review shows that there is no consensus yet on the technology-financial development-tax revenue nexus and several gaps still exist. The empirical research's findings are mixed, divergent and far from reaching a consensus. **Approach:** Panel methods such as fixed effects, fully modified ordinary least squares (FMOLS) and the dynamic generalized methods of moments (GMM) were used. The study used panel data spanning from 2009 to 2023. **Results:** Using individuals using the internet (% of population) as a proxy of technology, FMOLS and dynamic GMM shows that tax revenue was significantly enhanced by technology. Employing fixed telephone subscriptions (per 100 people) as a measure of technology, fixed effects and FMOLS noted that technology's enhancing influence on tax revenue was significant. FMOLS and fixed effects (model 2) also shows that financial development had a significant positive effect on tax revenue. All the three panel methods indicate that the complementarity between technology and financial development significantly improved tax revenue in transitional markets. **Implications:** Transitional markets are urged to implement technology and financial development enhancing policies to significantly improve and boost tax revenue collection. **Value:** Study reveals that financial development is important in helping technology's influence on tax revenue to be positive and significant in transitional markets.

Keywords: Panel Data; Financial Development; Tax Revenue; Technology

JEL Classification: C23; G15; H2; N7

1. Introduction and Background

The positive influence of technology in the economy is well documented and its no longer debatable in the field of finance, economics and geo-politics (Solomon & Klyton, 2020). Two theories generally come in handy. Firstly, the non-traditional view which says that information and communication technology (ICT) facilitates production spill-overs, business to business transactions and network externalities, hence spurring innovation in the economy (Paunov & Rollo, 2016). The neo-classical

¹ Professor, Department of Finance, Risk Management and Banking, University of South Africa, Pretoria, South Africa, Address: P.O. Box 392, UNISA 0003, Pretoria, South Africa, Corresponding author: tsaurk@unisa.ac.za.



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(traditional view) which was supported by Van Ark et al (2008) argued that information and communication technology spurs economic growth through investment in ICT related infrastructure (capital deepening).

Authors such as He (2024), Koivula et al. (2024) and Hanfy et al. (2024) argued that technology increases economic growth through its ability to raise tax revenue. Okunogbe and Tourek (2024) noted that technological advancement helps in improving taxpayer identification, tax collection and detecting tax evasion. Digitalizing tax administration systems deters tax fraud, evasion and improves efficiency, speed and effectiveness in tax revenue collection programmes (Nose & Mengistu, 2023). Yet, the literature on the influence of technology on tax revenue is not only quite scant but its results are mixed, conflicting, divergent and far from agreeing.

The empirical study on the relationship between technology and tax revenue produced mixed, divergent and conflicting results which are far from reaching a consensus. Majority of similar empirical studies supported the technology-led tax revenue hypothesis (Majeed & Ismail, 2022; He, 2024; Sapari et al., 2024; Selebogo, 2020; Bassongui & Hounghbedji, 2023; Okunogbe & Santoro, 2023; Oreku, 2021). Others noted that technology has a negative impact on tax revenue (Ackom et al., 2025) and the third group revealed that the influence of technology on tax revenue is non-significant and negligible (Mallick, 2020). The fourth group observed that availability of certain variables is necessary to enable technology to positively influence tax revenue (Jain, 2026). This study intends to add its voice and contribute to the literature on the ongoing discourse relating to the influence of technology on tax revenue in the context of transitional markets.

These empirical studies are fraught with several methodological shortcomings. Firstly, all of them ignored the endogeneity problem which normally characterises relationships between macroeconomic variables of this nature. Secondly, none of them focused on transitional markets, which is a key economic bloc in the present geo-political axis of the globe. Thirdly, the data used by most of them is now outdated. Fourthly, none of them considered the fact that tax revenue is also affected by prior self. Fifthly, none of them apart from acknowledging (Jain, 2026), investigated the channels through which technology influences tax revenue. The current study fills in these five gaps.

2. Literature Review

According to He (2024), the timeliness and accuracy of tax revenue collection is enhanced by precise evaluation and real time monitoring and assessment of tax calculations, collection and monitoring. This is made possible through automated data analysis and processing of tax calculations and assessments. On the other hand, tax authorities can quickly and easily comprehend taxpayer's business stature through big data technology applications which enables them to integrate and process big data resources (He, 2024, p. 87). The same author also argued that information technology through artificial intelligence sophistication and algorithms facilitates tax revenue data comparison, cleaning and analysis.

Information technology makes it easy for taxpayers to comply with tax laws as it enhances tax authorities to strengthen tax collection supervision and policies adherence (Koivula et al., 2024). The same author also argued that the tax payer's knowledge of tax policies, rules, procedures and consequently participation and compliance is enhanced as tax authorities can easily post such information on technology infrastructure platforms. Consistent with Hanfy et al. (2024), information

technology deters tax evasion through its ability to conducting risk assessments and creating tax profiles. Moreover, information technology provides convenience and tax efficient experience to the taxpayers through platforms such as mobile tax applications and e-tax bureaus (Li, 2020).

On the empirical front, several authors have attempted to contribute towards literature on technology-tax revenue nexus. Majeed and Ismail (2022) examined the role information technology on tax collection in Bagdad using a questionnaire method of data collection. The study revealed that information technology significantly reduced tax avoidance and evasion, hence overallly promoting tax revenue levels in Bagdad. Employing critical literature review analysis, He (2024) explored the impact of information technology on tax revenue. The study noted that information technology has a significant enhancing influence on tax compliance, administration and general tax collection quantities. Tax regulatory efforts, transparency and collection efficiency were enhanced by information technology, according to a majority of literature review.

Sapari et al (2024) employed conceptual research analysis approach to examine possible ways that technology infrastructure can enhance tax revenue in Malaysia. The study noted that technological advancements were quite instrumental in enhancing tax revenue collection, closing tax evasion loopholes and smoothening tax assessments in Malaysia. Selebogo (2020) critically examined the influence of digitalization on tax revenue in the fourth industrial revolution using a systematised literature review (critical literature review analysis). The study revealed that digitalization had a significant positive influence not only on tax revenue collection but also on reducing unemployment and enhancing economic growth. Employing the autoregressive distributive lag (ARDL) approach with time series annual data (1980-2019), Mallick (2020) investigated the impact of information and communication technology (ICT) on India's ability to mobilise tax revenue. The study observed that ICT and quality of governance had a non-significant enhancing effect on tax revenue collection in India.

Bassongui and Hounghbedji (2023) examined the role of tax digitalization on tax revenue collection in Sub-Saharan Africa (SSA) using a systematic and critical literature review analysis. The study noted that tax revenue collection was enhanced by the digital economy through tax compliance, e-governance and tax efficiency channels. The results of the study noted that information technology significantly enhanced tax revenue in SSA.

Ackom et al. (2025) investigated the impact of digitalization, tax compliance and tax system efficiency on tax revenue mobilization in SSA using fixed and random effects with panel data spanning from 2010 to 2022. The study noted that tax digitalization had a significant impact on tax revenue collection in SSA. The results also noted that tax digitalization's positive influence on tax revenue collection was enhanced by taxpayer digital literacy, infrastructural quality and sophisticated enforcement mechanisms. The study also observed that tax compliance burdens had a negative effect on tax revenue collection in SSA nations. Okunogbe and Santoro (2023) investigated the role of information technology on tax revenue collection in Africa using descriptive statistics and literature review analysis. Technology infrastructure was found to increase tax compliance, expand tax base and overallly boost tax revenue collection.

Oreku (2021) examined the impact of digital technology on tax revenue collection in Tanzania using descriptive statistical analysis. The study used interviews data collection approach from 137 micro businesses in Tanzania. The results show that technological infrastructure enhanced tax collection, compliance, assessments and consequently boost tax revenue in Tanzania.

Table 1. Technology advancement-led tax revenue hypothesis

Researchers	Country	Time span	Methodology	Results
Susilowati and Mappanyukki (2023)	Jakarta	2015-2019	Partial least squares-structural equation	The implementation of digital taxpayer knowledge and taxation reduced tax revenue obstacles and enhanced tax revenue collection targets.
Mokube and Linus (2023)	Africa	Literature review analysis	Literature review analysis	Technological advancements enhanced speed, efficiency, cost and convenience associated with tax collection efforts.
Uyar et al. (2021)	Developing countries	2006-2017	Fixed effects linear panel data analysis	The study noted that digitalization of government services played a significant role in reducing tax evasion, thereby increasing tax revenue collection.
Kgonare (2017)	Systematic and critical literature review	2007-2017	Systematic and critical literature review	Efficient and effective tax revenue administration and collection was enhanced by increased technological advancements.
Afriani et al. (2023)	Indonesia	Systematic literature review analysis	Descriptive statistics and critical literature review analysis	Advancement technology helped to reduce tax evasion and enhance tax revenue collection in Indonesia.
Gomba et al. (2024)	Nigeria	2013-2022	Descriptive statistics	Tax revenue collection was enhanced by digital technologies in Nigeria.
Nose et al. (2025)	Developing countries	2016 data	Descriptive statistics and critical literature review analysis	Advanced technological infrastructure helped to improve tax revenue collection and administration.
Akinyosoye et al. (2025)	Nigeria	2022 data from Federal Inland Revenue Service (FIRS)	Multiple regression analysis	Digitalization eliminated tax leakages and enhanced tax revenue collection.
Jain (2026)	Literature review analysis	Literature review analysis	Literature review analysis	Digitalization enhanced tax revenue collection through facilitating compliance, streamlining processes, accessibility and efficiency.
Adefulu et al. (2024)	Nigeria	2020 IFRS data set, 2021 revenue statistics in Africa data.	Multiple regression analysis	Tax compliance and revenue collection positively responded to tax digitalization efforts by the Nigerian government.
Umar et al. (2023)	Nigeria	Questionnaire data set	Analysis of variance (ANOVA)	A statistically significant influence of advanced technology on tax revenue collection was observed.

Source: Author compilation

Although majority of empirical literature indicates that technology advancement is necessary to improve tax revenue collection, other authors could not find any significant relationship between the two variables. Other empirical researchers also noted that infrastructural quality, taxpayer digital literacy and sophisticated enforcement mechanisms were necessary to enhance technology's impact on tax revenue collection (Ackom et al., 2025). It is therefore clear that there is no consensus yet on the influence of technology on tax revenue collection. It is also evident that literature on technology led tax revenue collection is still scant, thin and still needs expansion and unpacking.

3. Financial Development-Technology-Tax Revenue Nexus

According to Masiya et al. (2015), an increase in economy monetization which comes because of financial development boost the tax base and tax revenue collection. Moreover, financial development tilts the economy more from informal towards formal economic activities hence making it easier to collect more tax revenue. Financial development is also instrumental in advancing technology improvements, consistent with Gries et al. (2011) and Levine (1997). They both argued that a more developed financial sector is better able to drive technology innovation through providing research funds, information facilitation and risk management hence consequently lowering the costs. Yet, technology has shaped and improved the efficiency, effectiveness and speed associated with tax revenue collection (He, 2024; Koivula et al., 2024; Hanfy et al., 2024; Li, 2020).

4. Research Methodology

Using panel data (1996-2023) extracted from World Development Indicators, the study examined the impact of technology on tax revenue in transitional markets. The latter was chosen as a unit of analysis because of its geo-political significance and prominence during the last three decades. The major advantages of collecting secondary from World Development Indicators are that the database is reputable and the data itself is reliable and more recent.

Empirical research done by Uyar et al. (2021), Umar et al. (2023), Adefulu et al. (2024), Akinyosoye et al. (2025), Gomba et al. (2024), Afriani et al. (2023), Kgonare (2017), Mokube and Linus (2023), and Nose et al. (2025) informed the structure of the general model specification used in this study (see equation 1).

$$TR=f(TECH, FIN, HCD, URBAN, FDI, OPEN, GROWTH) \quad [1]$$

Where TR stands for tax revenue, TECH is technological advancements, FIN represents financial development whilst human capital development is abbreviated as HCD. Urbanization is denoted as URBAN, FDI is the net inflows of foreign direct investment whereas OPEN is trade openness. Economic growth is denoted by GROWTH. The choice of control variables was influenced by empirical research done by Susilowati and Mappanyukki (2023), Oreku (2021), Okunogbe and Santoro (2023), Ackom et al. (2025), Bassongui and Houngbedji (2023), Sapari et al. (2024), Majeed and Ismail (2022), and Mallick (2020).

Table 2 presents, describes and explains control variables in the tax revenue function.

Table 2. Control variables

Variable	Explanation	Influence (sign)
Human capital development	Chilima (2005, p. 57) argued that the more educated people are in a better position to under tax rules, implications and imperative to pay tax. Moreover, educated people are employable hence they contribute towards increased tax revenue through paying income tax. In addition, development of human capital produces intellectuals, technical, skilled and more productive workforce, whose contribution to industry, economic activities and consequently tax revenue collection is impeccable (Castro & Camarillo, 2014). Human capital development index to measure of human capital development.	+
Urbanization	In line with Chilima (2005), increase in formal work in response to urbanization increases the quantity of collected tax revenue. The size	+

	of the formal economy increases the tax base and overall tax revenue collection (Chilima, 2005). Urban population as a percentage of total population is the measure of urbanization used in this study.	
Foreign direct investment	FDI pushes for the increase of economic activities formalization and competitiveness. It also enhances the expansion and growth of economic activities, hence boosting the tax base and tax revenue collection (Amoh & Adom, 2017). Net foreign direct investment inflow was the measure of FDI employed for the purposes of this study.	+
Trade openness	Import duties contributes towards the overall increased tax base of a country (Castro & Camarillo, 2014). The same authors noted that an open economy spur increase economic growth, firms profitability and overall size of the taxable base. Trade openness leads to reduction of tariffs and trade barriers removal hence reducing the levels of tax collected (Baunsgaard & Keen, 2010). The proxy of trade openness used in this study is exports of goods and services as a ratio of gross domestic product (GDP).	+/-
Economic growth	According to Gupta (2007), increased economic activities lead to more firms being involved in profit making endeavours, which boosts tax base and tax revenue (excise duty, sales tax, corporate tax) collection. Gross domestic product per capita is the proxy of economic growth employed in this study.	+
Complementarity variable (financial development x technology)	A developed financial sector is more able to contribute towards technological innovation that spur economic activities and industry growth and consequently tax base expansion.	+

Source: Author

Equation 2 stands for the tax revenue function, in econometric terms.

$$TR_{it} = \beta_0 + \beta_1 TECH_{it} + \beta_2 FIN_{it} + \beta_3 (TECH_{it} \cdot FIN_{it}) + \beta_4 HCD_{it} + \beta_5 URBAN_{it} + \beta_6 FDI_{it} + \beta_7 OPEN_{it} + \beta_8 GROWTH_{it} + \mu + \varepsilon \quad [2]$$

Tax revenue (TR) is proxied by tax revenue as a ratio of GDP whilst two measures of technology were used in this paper. These are individuals using the internet as a ratio of population and fixed telephone subscriptions per 100 people.

The complementarity variable (technology x financial development) is included in equation 2. The inclusion of the variable is an attempt by this study to examine if financial development is a conduit through which technology significantly enhances tax revenue collection in transitional markets, in line with literature (Masiya et al., 2015; Gries et al., 2011; Koivula et al., 2024).

Consistent with Boateng et al. (2017), fixed effects approach was used to estimate equation 2 because of its superiority in managing omitted variable bias. Fully modified ordinary least squares (FMOLS) was also used as a robustness check measure to manage simultaneity bias.

One major methodological weakness of empirical research on influence of technology on tax revenue is that the dynamic nature of tax revenue was ignored. Equation 3 captures and addresses such a weakness by including TR_{it-1} in equation 3.

$$TR_{it} = \beta_0 + \beta_1 TR_{it-1} + \beta_2 TECH_{it} + \beta_3 FIN_{it} + \beta_4 (TECH_{it} \cdot FIN_{it}) + \beta_5 HCD_{it} + \beta_6 URBAN_{it} + \beta_7 FDI_{it} + \beta_8 OPEN_{it} + \beta_9 GROWTH_{it} + \mu + \varepsilon \quad [3]$$

The dynamic generalized methods of moments (GMM) was used to econometrically estimate equation 3. Hausman test was performed to choose on the suitability of either fixed or random effects models in econometrically estimating equation 2, in line with Boateng et al. (2017). The positive but insignificant Wald test value indicated that heteroscedasticity problem does not exist in the fixed effects approach. It is upon such basis that fixed effects was preferred an

5. Pre-Estimation Diagnostics

According to Table 3, there are three correlations which shows that there is a multi-collinearity problem between the variables. These are (1) technology and human capital development, (2) human capital development and economic growth and (3) urbanization and human capital development. This is in line with Stead (2007) whose study argued that any correlation at least 70% is prone to multi-collinearity problem.

Table 3. Correlation results

Variable	TR	TECH	FIN	HCD	URBAN	FDI	OPEN	GROWTH
TR	1.00							
TECH	0.12*	1.00						
FIN	0.20***	0.28***	1.00					
HCD	0.03	0.83***	0.14**	1.00				
URBAN	0.17**	0.61***	-0.17***	0.70***	1.00			
FDI	0.03	-0.0005	-0.24***	0.04	0.20***	1.00		
OPEN	0.29***	0.10	0.45***	0.26***	-0.16**	-0.07	1.00	
GROWTH	0.07	0.66***	0.26***	0.85***	0.53***	-0.08	0.28***	1.00

Source: Author

Table 4. Descriptive statistics

	TR	TECH	FIN	HCD	URBAN	FDI	OPEN	GROWTH
Mean	14.01	57.19	72.84	0.76	68.33	2.42	44.62	9 828.38
Median	13.85	57.40	51.15	0.76	73.61	2.22	36.07	7 972.54
Maximum	26.02	97.69	189.61	0.93	92.23	9.66	139.68	35 674.10
Minimum	6.73	5.12	12.42	0.52	30.59	0.01	10.71	1 124.52
Standard. deviation	3.66	23.36	45.89	0.08	16.38	1.39	29.65	7 274.45
Skewness	1.15	-0.28	0.70	0.03	-0.63	1.06	1.08	1.71
Kurtosis	4.92	2.21	2.14	2.98	2.37	5.52	3.73	5.76
Jarque-Bera	83.56	8.72	25.51	0.03	18.65	101.97	49.02	181.18
Probability	0.00	0.00	0.00	0.98	0.00	0.00	0.00	0.00
Observations	225	225	225	225	225	225	225	225

Source: Author

Table 4 shows that variables such as financial development, trade openness and economic growth had range values exceeding a nominal value 100. Standard deviations of economic growth and financial development were also above 40. These two statistical measures (standard deviation and range) indicates that there exist outliers in economic growth, trade openness and financial development variables. Only technology and urbanization variables are skewed to the left. The probabilities of all the variables except for human capital development are valued at zero, evidence that the data set used in this study is abnormally distributed. Consistent with Aye and Edoja (2017), the whole data set ended up being converted to natural logarithms to address and manage these statistical issues.

6. Results And Discussion

Table 5 presents results for panel stationarity tests. Not all variables were stable at level, thus prompting panel root tests at first difference.

Table 5. Panel stationarity tests - Individual intercept

Level stage				
Variable	Levin et al. (2002)	Im et al. (2003)	ADF (Augumented Dick Fuller)	PP (Phillip Perron)
LTR	0.19	0.29	25.94	28.44
LTECH	-4.36***	-0.90	50.43**	350.28***
LFIN	-3.46***	-0.98	36.73	306.47***
LHCD	-3.47***	-3.18***	59.35***	34.33
LURBAN	-4.55***	1.56	30.19	58.81***
LFDI	-3.92***	-4.02***	72.28***	118.94***
LOPEN	-2.21**	0.42	23.52	40.75*
LGROWTH	-4.30***	-1.40*	41.29*	146.90***
First difference stage				
LTR	-4.92***	-5.70***	86.28***	163.62***
LTECH	-9.14***	-6.87***	102.91***	168.03***
LFIN	-6.93***	-5.39***	85.16***	149.59***
LHCD	-31.96***	-23.12***	283.73***	120.94***
LURBAN	-6.29***	-2.00**	49.33***	151.41***
LFDI	-9.76***	-10.69***	155.89***	1082.89***
LOPEN	-8.84***	-6.93***	103.36***	157.91***
LGROWTH	-8.45***	-6.67***	99.12***	144.96***

Source: Author

First difference stage shows that data for all the variables were stable, hence the conclusion is that the variables were integrated of order 1 (Ayenew, 2022). Such a result paved way for panel co-integration tests, whose statistical output are presented in Table 6.

Table 6. Johansen Fisher's approach

Hypothesised number of co-integrating equations	Fisher's trace test	Probability	Fisher's max-eigen test	Probability
None	513.24	0.0000	111.93	0.0000
At most 1	198.27	0.0000	184.02	0.0000
At most 2	198.41	0.0000	108.17	0.0000
At most 3	107.29	0.0000	58.99	0.0000
At most 4	71.77	0.0000	57.17	0.0000
At most 5	28.14	0.0000	38.83	0.0000

At most 6	21.19	0.0000	31.80	0.0014
At most 7	19.21	0.0001	17.57	0.0008

Source: Author

There are at most seven co-integrating vectors among the relationship between the variables studied (see Table 6). It is evidence that a long run relationship exists, hence allowing the main statistical analysis to proceed (see Table 8, 9, 10).

Table 7 shows the reason why fixed effects was preferred ahead of random effects. The probability of zero indicates that the null hypothesis which says fixed effects should be accepted should be adopted.

Table 7. Hausman test results

Statistical test	Fixed effects		Random effects		FMOLS	
Test	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Hausman (Chi2)	9.21 ***	18.16 ***	8.87 ***	17.19 ***		
Wald tests (Chi 2)	4.08	10.75	5.93 **	41.31 ***		

***and ** denote 1% and 5% levels of significance, respectively.

Source: E-Views

The difference between model 1 and 2 is the proxy of technology used. Model 1 made use of individuals using the internet (% of population) whilst model 2 employed fixed telephone subscriptions (per 100 people) as proxies of technology.

Table 8. Fixed effects

Variable	Model 1	Model 2
TECH	0.01	0.64***
FIN	0.15	0.59***
TECH.FIN	0.06**	0.35***
HCD	0.17	0.04
URBAN	-0.31**	-0.33
FDI	0.02*	0.08**
OPEN	0.08**	0.73
GROWTH	0.67	0.15
Prob F-statistic	0.00	0.00
F-statistic	38.10	42.20
Adjusted R-squared	0.63	0.69

***, ** and * denote 1%, 5% and 10% levels of significance, respectively.

Source: E-Views

Fixed effects (model 1) and dynamic GMM (model 2) shows that technology had an insignificant positive influence on tax revenue whilst fixed effects (model 2), FMOLS (models 1 and 2) and the dynamic GMM (model 1) indicated a significant positive influence of technology on tax revenue. The results are in line with Koivula et al. (2024) whose study noted that information technology makes it easy for taxpayers to comply with tax laws as it enables tax authorities to strengthen tax collection supervision and policies adherence. It is also in support of earlier empirical research by Adefulu et al. (2024), Umar et al. (2023) and Akinyosoye et al. (2025).

Financial development's positive impact on tax revenue was found to be non-significant under fixed effects (model 1), FMOLS (model 1) and dynamic GMM (models 1 and 2). On the other hand, model 2 of the FMOLS and fixed effects produced results which show that financial development had a significant enhancing effect on tax revenue. The results generally indicate that financial development

improves tax revenue, in line with Masiya et al. (2015) whose study argued that financial development tilts the economy more from informal towards formal economic activities hence making it easier to collect more tax revenue.

Across all three panel methods (both models), tax revenue was significantly improved by the complementarity variable (technology x financial development). The results shows that financial development enhanced technology's ability to positively influence tax revenue in a significant way. The results generally support an argument by Gries et al. (2011) whose study noted that financial development is better able to advance the required funding to support technological advancement, which then makes it more efficient and effective to reduce tax evasion (He, 2024; Hanfy et al., 2024).

Table 9. FMOLS

	Model 1	Model 2
TECH	0.31*	0.63***
FIN	0.19	0.64***
TECH.FIN	0.54**	0.11***
HCD	0.16	0.31
URBAN	0.16	-0.76
FDI	0.04***	0.04***
OPEN	0.02	0.19
GROWTH	0.43	0.67
Observations	225	225
Number of countries	15	15
Adjusted R-squared	0.59	0.64

***, ** and * denote 1%, 5% and 10% levels of significance, respectively

Source: E-Views

According to Table 10, tax revenue was significantly improved by its own prior value (own lag), in line with literature which says that higher tax revenue spur capital expenditure options, firms' expansions and economic growth (Obadiaru et al., 2024).

Table 10. Dynamic GMM results

	Model 1	Model 2
TR _{it-1}	0.95***	0.95***
TECH	0.06*	0.14
FIN	0.31	0.37
TECH.FIN	0.11***	0.01*
HCD	0.8	0.03
URBAN	0.04	0.06
FDI	0.01	0.004
OPEN	0.02*	0.01
GROWTH	0.16	0.48
AR1	-0.35	-1.35
Pr > z	0.06	0.01
AR2	0.71	0.21
Pr > z	0.02	0.005
Sargan test	0.13	14.38
Prob test > chi2	0.34	0.59
Hansen test	51.29	35.72
	0.56	0.21

Prob test > chi2		
Observations	225	225
Number of countries	15	15

***, ** and * denote 1%, 5% and 10% levels of significance, respectively.

Source: E-Views

Across all three panel methods (both models), human capital development's impact on tax revenue was positive but non-significant, consistent with Castro and Camarillo (2014) whose study observed that human capital development produces intellectuals, technical, skilled and more productive workforce, whose contribution to industry, economic activities and consequently tax revenue collection is impeccable.

FMOLS (model 1) and the dynamic GMM (both models) shows that urbanization had a non-significant enhancing influence on tax revenue, resonating with Chilima (2005) whose study noted that an increase in formal work in response to urbanization spur the quantity of collected tax revenue. FMOLS (model 2) and fixed effects (model 2) indicates that urbanization's impact on tax revenue was negative and non-significant whilst tax revenue was negatively but significantly improved by urbanization under fixed effects (model 1). These results generally contradict available literature which argues that urbanization increases concentration of people in cities, increase demand for goods and services and businesses opportunities for entrepreneurs.

Models 1 and 2 under both fixed effects and FMOLS produced results which show that FDI's impact on tax revenue was significantly enhancing whilst dynamic GMM indicates a non-significant positive relationship running from FDI towards tax revenue. The results generally agree with a theoretical explanation that says foreign investment promotes expansion and growth of economic activities, hence boosting the tax base and tax revenue collection (Amoh & Adom, 2017).

Model 1 under fixed effects and dynamic GMM indicates that trade openness had a significant positive impact on tax revenue whilst model 2 (fixed effects, FMOLS, dynamic GMM) and model 1 (FMOLS) shows a non-significant positive relationship running from trade openness towards tax revenue. The results agree with Castro and Camarillo (2014) whose study noted that high trade openness means that import duties contributes towards overall tax base of the country. Tax revenue was non-significantly enhanced economic growth across all three panel approaches (both models), in general agreement with Gupta (2007) whose study noted that increased economic activities expands industry and creates opportunities for more players to participate in the economy.

7. Conclusion

This study examined the role of technology in tax revenue collection in transitional markets using panel data (2009-2023) analysis methods such as fixed effects, fully modified ordinary least squares (FMOLS) and the dynamic generalized methods of moments (GMM). It also explored if financial development is a channel through which technology enhanced tax revenue in transitional markets. Both theoretical and empirical literature review shows that there is no consensus yet on the technology-financial development-tax revenue nexus and several gaps still exist. The empirical research's findings are mixed, divergent and far from reaching a consensus. Using individuals using the internet (% of population) as a proxy of technology, FMOLS and dynamic GMM shows that tax revenue was significantly enhanced by technology. Employing fixed telephone subscriptions (per 100 people) as a measure of technology, fixed effects and FMOLS noted that technology's enhancing

influence on tax revenue was significant. FMOLS and fixed effects (model 2) also shows that financial development had a significant positive effect on tax revenue. All the three panel methods indicate that the complementarity between technology and financial development significantly improved tax revenue in transitional markets. The implication of the study is that transitional markets are urged to implement technology and financial development enhancing policies to significantly improve and boost tax revenue collection. Further research should focus on dynamic threshold effects of technology on tax revenue in transitional markets.

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