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Bond Markets Development, Technology Penetration and Economic Growth Nexus in Transitional Markets

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Abstract: **Objectives:** The study explored two objectives in the context of transitional markets. Firstly, the impact of bond markets on the economy. Secondly, role of the complementarity between bond markets, technology and economy. **Prior Work**: Existing research work on the bond markets-economic growth and technology nexus produced results which are inconclusive and indecisive. **Approach:** Fully modified ordinary least squares (FMOLS), fixed-effects and system generalized methods of moments (GMM) were the panel methods employed. Panel data used ranges from 2007 to 2021. **Results:** In both models, bond market development significantly improved economic growth (system GMM, fixed effects) whereas the same results were noted in model 2 under FMOLS. FMOLS and system GMM (both models) shows that technology significantly enhanced economic growth and same results were observed under fixed effects, in model 2. All three econometric methods (both models) presented results indicating that economic growth was significantly enhanced by the complementarity element of the model. **Implications**: Bond markets and technological progress enhancement policies should be implemented by transitional markets to spur economic growth. **Value:** The conclusion is that bond markets and technology are vital elements of the economic growth process in transitional markets.

Keywords: Panel Data; Transitional Markets; Technology; Bond Market; Growth

JEL Classification: F43; N7; P2; R53

1. Introduction and Background

According to Oke et al. (2021), the role of a strong financial sector in stimulating industrial activities and economic growth is indisputable. A developed financial

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sector mobilise savings, ameliorate risk in the economy, ensure allocation of financial resources is done in an efficient manner and creates viable investment opportunities. One of the important ingredients necessary in ensuring a developed financial sector is bond market, whose definition is a long-term financial debt tradable instrument (Oke et al., 2021, p. 61). Consistent with Nkwede et al. (2016), Peiris (2010), Akinsokeji (2016), bond market development plays a critical role in the economy, such as ensuring financial stability, economic transformation and addresses long term capital needs in the economy. This is consistent with the supply leading hypothesis, which says that bond market development inspires economic growth (Peia & Roszbach, 2015).

Several empirical researches work in a similar field attempted to establish the causality but produced mixed, varied, divergent and conflicting conclusions. Some researchers found out that bond markets enhanced the economy (Nneka et al., 2025; Wahidin et al., 2021; Ugbam et al., 2023; Aman et al., 2023; Fink et al., 2003; Oke et al., 2021; Pradhan et al., 2020; Olaniyan & Ekundayo, 2019; Argandona et al., 2022; Kapingura & Makheta-Kosi, 2014) and others noted that bond market development negatively influenced economic growth (Petlele & Buthelezi, 2025; Fink et al., 2003; Oke et al., 2021; Abbas & Christensen, 2007; Puscasu, 2024). Other empirical researchers found results which confirms a feedback effect (Pradhan et al., 2015) and yet another group observed results which failed to establish a link between the two variables (Fink et al., 2003; Muharam et al., 2018). Other empirical researchers observed that the impact of bond markets in the economy happens through some channels, not in a direct way. These contradictions in findings tempted the author to carry out further empirical investigations on the subject matter.

Research Problem and Objective: Empirical research that explored the influence of bond markets in the economy suffers few methodological shortcomings, as discussed next. They ignored endogeneity problem (Nneka et al., 2025; Wahidin et al., 2021; Pradhan et al., 2015; Petlele & Buthelezi, 2025; Fink et al., 2003; Oke et al., 2021; Pradhan et al., 2020; Abbas & Christensen, 2007; Puscasu, 2024; Muharam et al., 2018; Roberts & Onyejiuwa, 2021). Transitional markets were not focused on yet they form an economic grouping that experienced rapid growth in FDI, economic growth and financial markets during the last three decades (Nneka et al., 2025; Ugbam et al., 2023; Aman et al., 2023; Fink et al., 2003; Oke et al., 2021; Roberts & Onyejiuwa, 2021; Puscasu, 2024).

The influence of a complementarity between bond markets and any other macroeconomic variable on the economy has so far not yet been investigated. Majority of them wrongly assumed that the influence of bond market development on economic growth is linear (Nneka et al., 2025; Ugbam et al., 2023; Petlele & Buthelezi, 2025; Pradhan et al., 2020; Roberts & Onyejiuwa, 2021). Majority of these empirical research used old data sets (Muharam et al., 2018; Wahidin et al.,

2021; Pradhan et al., 2015; Aman et al., 2023; Fink et al., 2003; Pradhan et al., 2020; Abbas & Christensen, 2007). The current study fills in these gaps.

2. Literature Review

Relevant theories include demand following hypothesis, feedback hypothesis and supply leading hypothesis, consistent with Nneka et al. (2025). In line with Pradhan et al. (2015), the demand following hypothesis argues that economic growth improves the bond markets. It explains that as the economy begins booming, bond market grows to meet increased appetite for capital markets linked services.

According to supply leading hypothesis, bond market development inspires economic growth through its ability to reduce information asymmetry, promoting commodity exchange, liquidity management and risk amelioration (Peia & Roszbach, 2015). Feedback hypothesis explains that bond markets and the economy enhance one another. These two variables are said to be in a mutually beneficial relationship (Muharam et al., 2018).

Several empirical research on the subject matter have been done. Nneka et al. (2025) used the autoregressive distributed lag (ARDL) to investigate the influence of bond market development on economic growth in developing countries. The data used ranged from 1990 to 2020. The study noted that government bonds enhanced the economy whilst corporate bonds had a deleterious effect on the economy. Employing panel data (1990-2017) analysis, Wahidin et al. (2021) examined the economic growth influence of bond market development during, before, during and after the global financial crisis in both developed and developing countries. The study observed the distortion role played by the global financial crisis on the nexus between bond markets and the economy was quite significant in developing countries.

Ugbam et al. (2023) examined the bond market development-economic growth nexus in developing countries using the system GMM approach with panel data spanning from 2015 to 2022. Corporate bonds, government bonds and bond yields were collectively and individually found to have positively enhanced economic growth in developing countries. Using vector autoregressive (VAR) approach, Pradhan et al. (2015) examined the Granger causality between bond market development and economic growth in G-20 group of countries. The data used ranged between 1990 and 2011. Bond markets enhanced the economy whilst a bi-directional causality relationship was also observed in the long and short run.

Examining the relationship between shocks in government bonds and the economy in South Africa, Petlele and Buthelezi (2025) employed the structural vector autoregression analysis. The study used time series data (1986-2024). Bond yields

in the short run led to a deleterious effect on the economy. In the long run, bond yields had a W-shaped type of an impact on economic growth. Initially causing a decline in economic growth then followed by a subsequent growth in the economy. Aman et al. (2023) explored the interrelationship between bond market development and macroeconomic factors in selected developing and developed countries using panel data (1993-2017) analysis. The study observed that bond market development was positively related to only the financial sector but to majority of the macroeconomic variables.

Fink et al. (2003) studied the linkage between bond markets and economic growth in developed countries using the vector autoregressive (VAR) approach, employing panel data (1950-2000). A feedback relationship was observed in the case of Japan, Italy and Finland. Bond market development's positive impact on the economy was significant in Great Britain, United States of America, German, Switzerland and Austria. Spain and Netherlands showed a non-significant positive effect of bond markets on the economy. Employing the co-integration bond test methodology and time series data (1986-2018), Oke et al. (2021) examined the linkage between bond market development and economic growth In Nigeria. The results are in three different sets. Firstly, economic growth was negatively affected by the bond yield. Secondly, a significant enhancing influence of corporate bonds on the economy was observed. Thirdly, government bonds enhanced the economy, non-significantly.

Pradhan et al. (2020) examined the dynamic relationship between bond market development, economic growth and stock market development in G-20 countries using the panel VAR approach. Panel data used began from 1991 to 2016. In the long run, economy was enhanced not only by bond market development but also by stock market development and real interest rate. Olaniyan and Ekundayo (2019) employed the GMM methodology to explore the relationship between government bonds and economic growth in Nigeria. The time series data used (2010-2017). Government bonds significantly improved the economy in Nigeria. Same study observed that low capitalization of government bonds had a deleterious impact on economy of Nigeria.

Employing multi-linear regression analysis, Argandona et al. (2022) examined the relationship between bond issuance and economic growth in the Caribbean and Latin American region. The study noted that the issuance of bonds spurred the economy in both Caribbean and Latin America. Abbas and Christensen (2007) also explored the role of domestic debt markets on economic growth of emerging markets and low-income group of countries using panel data (1975-2004) analysis. The study observed that domestic debt market began to negatively influence economic growth above the threshold level of 35% of bank deposits. Channels such as enhanced monetary policy, domestic institutions, financial development and private savings

were found to have a significant influence on domestic debt market's ability to spur economic growth.

Employing ARDL approach and time series data (1981-2019), Roberts and Onyejiuwa (2021) examined the influence of bond market on growth of capital market in Nigeria. Bond markets significantly enhanced capital markets in Nigeria in the long run. Using South Africa's quarterly data (1995-2012), Kapingura and Makhetha-Kosi (2014) studied the causal linkage between the variables. Pair wise Granger causality and Engle Granger co-integration approaches were used. Bond markets' impact on the economy of South Africa was significantly enhancing, in the long run. Employing vector error correction model (VECM) and data spanning from 2005 to 2020, Pradhan et al. (2023) explored the interrelationship between economy, institutional quality and bond markets. Results showed that both institutional quality and economy explained the development of bond markets in short and long run. Reverse causality was not observed.

Puscasu (2024) studied the impact of bond market development on economic growth in European Union countries using panel data (2005-2021) analysis. Bond yields and corporate bonds had a negative economic effect all the econometric models employed. Muharam et al. (2018) examined the linkage between economic growth, bond market development and foreign direct investment (FDI) in developing countries using VAR and VECM approaches. The data used started from 2004 to 2015. The co-integration between the three main variables was observed. The study found no causality relationship between variables studied.

3. Impact of Technology on Economic Growth - A Theoretical View

Consistent with Rammbuda and Mafukata (2022), technology enhances economic growth in four different ways. Technology facilitates more and easy access to jobs and money thereby helping in leveling economic playing field (Moed, 2018). Kang (2022) also argued that businesses and people's well-being and productivity improves in direct response to adoption and development of technology. Technology helps to commercialize goods and services produced by the people hence facilitating job creation and poverty alleviation in the economy, according to Noumba (2017).

According to Lucas (1988)'s endogenous growth theory, technological progress alongside innovation are key production inputs into the economic growth process. According to Faishal et al. (2023), technological innovations spur economic through its ability to enhance effective and efficient communication, promote safe and secure digital payment platforms, establish online market places, develop biometric identification systems and artificial intelligence platforms. Such an argument on the technology-growth nexus was extensively supported by Pourehtesham (2022).

4. Methodology

The study used panel data (2007-2021) to explore the bond markets-economic growth link in transitional markets. Timeframe was selected due to data availability considerations and compatibility with the econometric methods used. The data was extracted from international database (World Development Indicators). The advantages of these international databases are that they are reliable, public viewable, consistent and verifiable. Indonesia, Turkey, Argentina, South Africa, Republic of Korea, Mexico, Colombia, China, Czech Republic, India, Malaysia, Philippines, Thailand, Brazil and Peru are the transitional economies that constituted the sample. Data availability was the main factor considered in choosing the countries to include in the sample.

Equation 1 describes economic growth function, in broader terms.

GROWTH= f (BOND, TECH, FDI, HCD, OPEN, TR, FIN)   [1]

Where GROWTH represents economic growth, BOND is bond market development, TECH is technology whilst FDI is foreign direct investment. Human capital development is represented by HCD. Trade openness is OPEN, tax revenue is represented by TR whilst FIN stands for financial development. The choice of the variables included in the economic growth function is consistent with earlier empirical studies such as Oke et al. (2021), Wahidin et al. (2021), Ugbam et al. (2023), and Wahidin et al. (2021).

Gross domestic product (GDP) per capita is the economic growth measure employed. Outstanding domestic private debt securities as a ratio of GDP and outstanding domestic public debt securities as a ratio of GDP were used to mimic the bond markets. Technology was measured using individuals using the internet (% of the population). FDI was proxied by net FDI as a ratio of GDP whilst human capital development index measured the development of human capital. Total trade as a ratio of GDP, total revenue (% of GDP) and domestic credit to private sector (% of GDP) were employed as measures of trade openness, tax revenue and financial development respectively. The selection of these measures is consistent with earlier empirical research work done by Puscasu (2024), Muharam et al. (2018), Pradhan et al. (2023), Kapingura and Makhetha-Kosi (2014), Roberts and Onyejiuwa (2021), Abbas and Christensen (2007), Argandona et al. (2022), Olaniyan and Ekundayo (2019) and Pradhan et al. (2020).

Table 1. A discussion of control variables' a priori influence on economic growth

Variable	Theoretical explanation	Impact
Foreign direct investment (FDI)	Romer (1986) and Fu et al. (2011) argued that FDI spurs economic growth of a host country through bringing in managerial skills, human capital development, physical capital and technology. The dependence theory argues	+/-

	that FDI negatively affects the economy (Amin, 1974). The study noted that an economy controlled by foreigners in form of FDI cannot organically grow, thereby stimulating long term economic growth retardation.	
Human capital development (HCD)	Pelinescu (2015) observed that development of human capital contributes towards innovation and technological happens through its ability to provide educated, skilled and healthy workforce in the economy.	+
Trade openness (OPEN)	According to Hart (1983) foreign currency that comes in as a direct result of international trade is quite important for economic growth. Trade openness also allows local firms to easily and inexpensively acquire raw materials from across the globe and helps them to sell their produce in international commodity markets (Coe & Helpman, 1995). Baltagi et al. (2009) highlighted that trade openness's impact on the local economy is deleterious if foreign products are more preferred hence stifling the local industry and economic growth.	+/-
Tax revenue (TR)	Higher levels of tax revenue allow the government to have more financial resources to spend towards investment in education, health, infrastructure, technological innovation and new products invention, thereby spurring economic growth (Ho et al., 2023).	+
Financial development (FIN)	A highly developed financial system is better able to ameliorate risk, pool savings and allocates the scarce financial resources towards the most efficient investment projects in the economy (McKinnon, 1973; Shaw, 1973).	+

Source: Author

Equation 2 is an econometric model specification of economic growth function.

$$\text{GROWTH}_{it} = \beta_0 + \beta_1 \text{BOND}_{it} + \beta_2 \text{TECH}_{it} + \beta_3 (\text{BOND}_{it} \cdot \text{TECH}_{it}) + \beta_4 \text{FDI}_{it} + \beta_5 \text{HCD}_{it} + \beta_6 \text{OPEN}_t + \beta_7 \text{TR}_{it} + \beta_8 \text{FIN}_{it} + \mu + \varepsilon \qquad [2]$$

The complementarity variable (BOND x TECH) is introduced in equation 2, in line with an argument by Faishal et al. (2023) whose study noted that technological innovations spur economic through its ability to promote safe and secure digital payment platforms of bond transactions and establish online bond market places. If the co-efficient β_3 is significant and negative, it means that bond markets negatively affect economic growth through the technology channel. Panel methods (FMOLS, fixed effects) estimated equation 2.

$$\text{GROWTH}_{it} = \beta_0 + \beta_1 \text{GROWTH}_{it-1} + \beta_2 \text{BOND}_{it} + \beta_3 \text{TECH}_{it} + \beta_4(\text{BOND}_{it} \cdot \text{TECH}_{it}) + \beta_5 \text{FDI}_{it} + \beta_6 \text{HCD}_{it} + \beta_7 \text{OPEN}_t$$
$$+ \beta_8 \text{TR}_{it} + \beta_9 \text{FIN}_{it} + \mu + \varepsilon \qquad [3]$$

Equation 3 include the lag of economic growth (GROWTH_{it-1}) as an independent variable, consistent with Cavalcanti et al. (2015). System GMM is an econometric approach used to estimate equation 3 because of its superior ability to address endogeneity issue.

5. Main Data Analysis and Findings

Table 2 presents the correlation values of employed variables. In support of Stead (1996), all values are below the 0.70 threshold. Hence, the model does not have a problem of multi-collinearity.

Table 2. Correlation matrix of the variables

	GROWTH	BOND	TECH	FDI	HCD	OPEN	TR	FIN
GROWTH	1.00							
BOND	0.47***	1.00						
TECH	0.67***	0.46***	1.00					
FDI	**-0.09**	**-0.12***	**-0.04**	1.00				
HCD	0.69***	0.27***	0.63***	0.07	1.00			
OPEN	0.27***	0.47***	0.14**	-0.06	0.21***	1.00		
TR	0.08	-0.02	0.11	0.01	0.03	0.32***	1.00	
FIN	0.25***	0.69***	0.34***	-0.22***	0.07	0.46***	0.27***	1.00

Source: Author

In line with Table 3, range for economic growth is US$34 102.94 per capita, range for trade openness is 129.73% of GDP whilst range for financial development is 191.22% of GDP. These ranges which exceeds the nominal value of 100 shows that outliers exist. The standard deviation (6,853.29) of economic growth is another indication of the existence of outliers in that data set. The probability of 0 which characterizes the Jaque-Bera criterion for all the variables used is an indication of the existence of abnormal values. To address these undesirable statistical features,

all the data sets were converted into natural logarithms, consistent with Aye and Edoja (2017)'s argument.

Table 3. Descriptive statistics

	GROWTH	BOND	TECH	FDI	HCD	OPEN	TR	FIN
Mean	9262.22	21.31	50.09	2.53	0.75	46.92	14.06	72.60
Median	7647.68	13.97	51.00	2.30	0.76	39.24	13.71	51.84
Maximum	35125.52	81.66	97.60	9.66	0.94	140.44	25.89	203.53
Minimum	1022.58	0.05	3.95	0.01	0.08	10.71	7.97	12.31
Standard deviation	6853.29	22.04	23.97	1.44	0.09	31.28	3.50	45.99
Skewness	1.64	0.94	-0.07	1.00	-1.64	1.00	1.30	0.66
Kurtosis	5.61	2.58	2.09	5.18	14.28	3.46	5.17	2.13
Jarque-Bera	164.85	34.94	7.87	82.87	1292.83	39.82	108.03	23.24
Probability	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Observations	225	225	225	225	225	225	225	225

Source: Compilations by author

To establish panel stationarity of data used, Im, Perasan and Shin, Phillip and Perron (PP), Augmented Dickey Fuller (ADF) and Levin, Lin and Chu unit root tests were performed (see results in Table 4). For many variables used, the null hypothesis of the existence of unit root is accepted as shown by high p values, which are greater than 0.1 in most cases. This means that FDI data is the only one which is stationary across all the four approaches used, hence prompting the author to try first difference level. Non-acceptance of null hypothesis for all the variables used across the four methods means that the data series is integrated of the first order (Aye and Edoja. 2017: 14).

Table 4. Stationarity tests of panel data –Individual intercept

Level				
	Levin et al. (2002)	Im et al. (2003)	Augmented Dick Fuller Fisher Chi Square	Phillip Peron
LGROWTH	-3.43***	-0.70	31.53	76.79***
LBOND	-2.73***	-1.23	35.41	26.32
LTECH	-3.38***	-0.08	47.65**	111.96***
LFDI	-4.94***	-3.45***	64.30***	104.26***
LHCD	2.76	0.49	21.36	61.06***
LOPEN	-1.49*	0.68	29.32	32.96
LTR	1.29	1.56	17.68	22.45
LFIN	-0.50	2.33	21.91	48.50*
First difference				
LGROWTH	-6.47***	-4.37***	70.56***	138.31***
LBOND	-8.37***	-5.52***	84.40***	111.77***

LTECH	-3.02***	-4.01***	67.13***	156.37***
LFDI	-10.52***	-9.16***	132.74***	272.82***
LHCD	-25.52***	-22.09***	243.31***	341.43***
LOPEN	-4.71***	-4.33***	70.94***	122.06***
LTR	-5.81***	-4.51***	74.83***	120.58***
LFIN	-3.06***	-3.75***	66.97***	156.47***

Source: Author

The empirical results are presented in Tables 5 (fixed effects), 5 (FMOLS) and 6 (system GMM). The only difference between model 1 and 2 is because of the measure of bond market development used. Model 1 used outstanding domestic private debt securities (% of GDP) whilst model 2 employed outstanding domestic public debt securities (% of GDP) as measures of bond markets.

Table 5. Fixed effects

	1	2
BOND	0.10*	0.20***
TECH	0.05	0.22***
BOND.TECH	0.02**	0.04***
FDI	0.01*	0.01*
HCD	0.05	0.03
OPEN	0.15***	-0.41***
TR	0.15	0.37
FIN	0.09*	0.09**
F-statistic	186.79	192.09
Prob (F-statistic)	0.00	0.00
R-squared (adjusted)	0.65	0.58

Source: Author

System GMM shows that economic growth was significantly increased by its own lag, in support of Cavalcanti et al (2015). Fixed effects (model 1 and 2), FMOLS (model 2) and system GMM (both models) indicates that bond market development significantly improved economic growth. FMOLS (model 1) shows a non-significant relationship running from bond market development towards economic growth. These results agree with the supply leading hypothesis explained earlier on by Peia and Roszbach (2015). Technology had a significant enhancing effect on economic growth under fixed effects (model 2), FMOLS (both models) and system GMM (both models). However, fixed effects (model 1) indicates that technology non-significantly enhanced economic growth. The results support earlier studies by Lucas (1988)'s endogenous growth theory which argued that technological progress alongside innovation are key production inputs into the economic growth process.

In both models, the complementarity between bond markets and technology improved the economy significantly across all three econometric estimation approaches. These results resonate with Faishal et al. (2023) who argued that

technological innovations spur economic through its ability to promote safe and secure digital payment platforms of bond transactions and establish online bond market places.

Table 6. FMOLS

	1	2
BOND	0.16	0.29**
TECH	0.13*	0.39***
BOND.TECH	0.02***	0.58***
FDI	0.01*	0.02*
HCD	0.03	0.46
OPEN	-0.30***	-0.36***
TR	0.05	0.06
FIN	0.11*	0.11
Adjusted R-squared	0.58	0.62

Source: Author

Fixed effects and FMOLS shows that FDI significantly increased economic growth in both models, consistent with Fu et al. (2011) and Romer (1986) whose argument was that human capital development, technology, managerial skills and physical capital which flows alongside FDI are of paramount importance in the economic growth process. System GMM indicates (1) significant deleterious impact of FDI on the economy in model 2 and (2) a non-significant deleterious effect of FDI on the economy in model 1. These results generally agree with the dependence theory as earlier on explained by Amin (1974).

In all the three econometric methods (both models), human capital development non-significantly increased economic growth, in general agreement with Pelinescu (2015)'s assertion that human capital development's contribution towards innovation, technological progress and economic growth happens through its ability to provide educated, skilled and healthy workforce.

Table 7. System GMM

	1	2
$GROWTH_{it-1}$	0.05***	0.01***
BOND	0.48*	0.06**
TECH	0.07*	0.85*
BOND.TECH	0.73**	0.77***
FDI	-0.75	-0.45***
HCD	0.02	0.17
OPEN	0.11*	0.80*
TR	0.31	0.06
FIN	0.13***	0.07***

AR1	-1.56	-2.6
Pr > z	0.05	0.032
AR2	0.82	0.35
Pr > z	0.03	0.008
Sargan test	0.17	19.27
Prob test > chi2	0.43	0.62
Hansen test	54.93	28.33
Prob test > chi2	0.72	0.39
Observations	225	225
Number of countries	15	15

Fixed effects (model 1) and system GMM (both models) show that economic growth was significantly improved by trade openness, in line with an argument by Hart (1983) which says that international trade brings foreign currency into the exporting country whose importance in the economy cannot be overstated. Fixed effects (model 2) and FMOLS (both models) indicates a significant negative effect of trade openness on economic growth, consistent with Baltagi et al. (2009)'s argument that trade openness can have a negative influence on the local economy if foreign manufactured products are more preferred locally.

In all three econometric methods, tax revenue improved the economy in a non-significant way. Such results generally agree with Ho et al. (2023)'s explanation that higher tax revenue balances enable the central government to put more financial resources towards investments that spur economic growth.

Model 1 (fixed effects, system GMM, FMOLS) and model 2 (fixed effects, system GMM) indicates that financial development significantly improved economic growth. Model 2 (FMOLS) shows that the economy was non-significantly increased by financial development. These results resonate with McKinnon (1973) and Shaw (1973) whose argument is that a developed financial system enhances economic growth by pooling savings from the surplus sector and allocating them towards the deficit sector of the economy, efficient allocation of financial resources and risk amelioration.

6. Conclusion

The study explored two objectives in the context of transitional markets. Firstly, the impact of bond markets on the economy. Secondly, role of the complementarity between bond markets, technology and economy. FMOLS, fixed-effects and system GMM were the panel methods employed. Panel data used ranges from 2007 to 2021.

In both models, bond market development significantly improved economic growth (system GMM, fixed effects) whereas the same results were noted in model 2 under FMOLS. FMOLS and system GMM (both models) shows that technology significantly enhanced economic growth and same results were observed under fixed effects, in model 2. All three econometric methods (both models) presented results indicating that economic growth was significantly enhanced by the complementarity element of the model. The conclusion is that bond markets and technology are vital elements of the economic growth process in transitional markets. Bond markets and technological progress enhancement policies should be implemented by transitional markets to spur economic growth. Future studies on threshold levels of bond market development necessary to significantly influence economic growth should be undertaken.

References

Abbas, S. M. A., & Christensen (2007). *The role of domestic debt markets in economic growth: An empirical investigation for low-income countries and emerging markets*. International Monetary Fund (African Department) Working Paper Series Number WP/07/127.

Aman, A., Isa, M. Y., & Naim, A. M. (2023). The role of macroeconomic and financial factors in bond market development in selected countries. *Global Business Review, 24*(4), 626-641.

Amin, S. (1974). *Accumulation on a world scale: A critique of the theory of underdevelopment*. New York: Monthly Review Press.

Argandona, L. C. B., Rambaud, S. C., & Pascual, J.L. (2022). The impact of sustainable bond issuances in the economic growth of the Latin American and Caribbean countries. *Sustainability,* 14, 1-19.

Aye, G. C., & Edoja, P. E. (2017). Effect of economic growth on CO_2 emission in developing countries: Evidence from a dynamic panel threshold model. *Cogent Economics and Finance, 5*(1), 1-22.

Baltagi, B. H., Demitriades, P. O., & Law, S. H. (2009). Financial development, openness and institutions: Evidence from panel data. *Journal of Development Economics, 89*(2), 285-296.

Cavalcanti, T. V. D. V., Mohaddes, K., & Raissi, M. (2015). Commodity price volatility and the sources of growth, *Journal of Applied Econometrics, 30*(6), 857-873.

Coe, T. D., & Helpman, E. (1995). International research and development spillovers. *European Economic Review*, *39*(5), 859-887.

Faishal, M., Mathew, S., & Yanyhan, L. (2023). Tech-tonic shifts: Exploring the impact of technology on the Indian economy. *International Journal of Novel Research and Development, 8*(5), 177-188.

Fink, G., Haiss, P., & Hristoforova, S. (2003). *Bond markets and economic growth*. SSRN Electronic Journal.

Fu, X., Pietrobelli, C., & Soete, L. (2011). The role of foreign technology and indigenous innovation in the emerging economies: Technological change and catching up. *World Development, 39*(7), 1204-1212.

Hart, O. (1983). The market mechanism as an incentive scheme. *Bell Journal of Economics*, *14*(2), 366-382.

Ho. T. T., Tran, X. H., & Nguyen, Q. K. (2023). Tax revenue-economic growth relationship and the role of trade openness in developing countries. *Cogent Business and Management*, 10(2023), 1-14.

Im, K. S., Pesaran, M. H., & Shin, Y. (2003). Testing unit roots in heterogeneous panels. *Journal of Econometrics, 115*(1), 53-74.

Kang, J. (2022). *Technology trends changing out lives in 2022*. Johannesburg: LG Electronics.

Kapingura, F., & Makhetha-Kosi, P. (2014). The causal relationship between the bond market development and economic growth in Africa: Case study of South Africa. *Mediterranean Journal of Social Sciences, 5*(3), 126-131.

Levin, A., Lin, C. F., & Chu, C. S. J. (2002). Unit root tests in panel data: Asymptotic and finite-sample properties. *Journal of Econometrics, 108*(1), 1-24.

Lucas, R. E. (1988). On the mechanics of economic development. *Journal of Monetary Economics, 22*(1), 3-42.

McKinnon, R. I. (1973). *Money and Capital in Economic Development.* Washington, D.C.: The Brooklings Institution.

Moed, J. (2018). *How can technology make South Africa a more equal country?*

Muharam, H., Ghozali, I., & Arfinto, E. D. (2018). Bond market development, economic growth and the role of foreign investment, *Proceedings of the 2018 International Conference of Organizational Innovation, KnE Social Sciences,* Fukuoka, July 2018, 811-819.

Nneka, U. J., Ngong, C. A., Ugoada, O. A., & Onwumere. J. U. J. (2025). Effect of bond market development on economic growth of selected developing countries. *Journal of Economic and Administrative Sciences, 41*(1), 132-148.

Noumba, P. (2017). *South Africa economic update: More innovation could improve productivity, create jobs and reduce poverty*. World Bank.

Oke, M. O., Dada, O., & Aremo, N. O. (2021). Impacts of bond market development on the growth of the Nigerian economy. *Folia Oeconomica Stetinensia, 21*(1), 60-75.

Olaniyan, T. O., & Ekundayo, S. O. (2019). Revisiting the growth effects of government bonds in an emerging capital market. *Corporate Governance and Organizational Behaviour Review, 3*(1), 32-38.

Peia, O., & Roszbach, K. (2015). Finance and growth: time series evidence on causality, *Journal of Financial Stability, 19*(3), 105-118.

Pelinescu, E. (2015). The impact of human capital on economic growth, *Procedia Economics and Finance, 22*(2015), 184-190.

Petlele, O., & Buthelezi, E. M. (2025). Shocks of government bonds and yield impact economic growth in South Africa. *Cogent Economics and Finance, 13*(1), 1-24.

Pourehtesham, M. (2022). The relationship between technology and economic growth: The moderating role of human capital. *International Journal of Human Capital in Urban Management, 7*(4), 561-570.

Pradhan, R. P., Aggarwal, N., & Abraham, R. (2023). Are bond markets, economic growth and institutional quality related? Evidence from VECM estimation. *Economics Bulletin, 43*(1), 1-12.

Pradhan, R. P., Arvin, M. B., Norman, N. R., & Bahmani, S. (2020). The dynamics of bond market development, stock market development and economic growth. Evidence from the G-20 countries. *Journal of Economics, Finance and Administrative Science, 25*(49), 119-147.

Pradhan, R. P., Zaki, D. B., Maradana, R. P., Dash, S., Jayakumar, M., & Chatterjee, D. (2015). Bond market development and economic growth: The G-20 experience: *Review of Applied Management Studies, 13*(2015), 51-65.

Puscasu, E. (2024). Exploring the role of bond markets in economic growth: Evidence from a split-sample analysis of EU countries. *Technium Social Sciences Journal*, *70*(1), 193-211.

Rammbuda, M. C., & Mafukata, M. A. (2022). Exploring the impact of technology on the economy in the Republic of South Africa. *The 7th Annual International Conference on Public Administration and Development Alternatives, 14-16 September 2022.*

Roberts, B. O., & Onyejiuwa, D. C. (2021). The long run impact of bond market on the growth of the capital market in Nigeria. *The International Journal of Business and Management*, *9*(10), 175-184.

Romer, P. (1986). Increasing returns and long run economic growth. *Journal of Political Economy*, *94*(5), 1002-1037.

Shaw, E. S. (1973). *Financial Deepening in Economic Development*. New York: Oxford University Press.

Stead, R. (1996). *Foundation quantitative methods for business*. Prentice Hall. England.

Ugbam, C. O., Ngong, C. A., Abner, I. P., & Ibe, G. I. (2023). Bond market development and economic growth nexus in developing countries; A GMM approach. *Journal of Economic and Administrative Sciences*, *41*(5), 1962-1976.

Wahidin, D., Akimov, A., & Roca, E. (2021). The impact of bond market development on economic growth before and after the global financial crisis: Evidence from developed and developing countries. *International Review of Financial Analysis,* 77(October), 1-11.