

ICT and Stock Market Nexus in Africa: Evidence from Nigeria and South Africa

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Abstract: Several studies have examined ICT in relation to stock market development, economic growth and development and other macroeconomic variables. Most of the studies have been on the developed and emerging economies. Studies have been relatively scanty for the developing economies, especially Sub-Saharan Africa. Thus, knowledge gap has been identified in the literature for the African Continent. Pooled data were used in this paper to spur further studies on financial markets in Africa. This paper employed data on functional models adapted from Gompertz curve model for technology diffusion to investigate the effects of ICT on market outcomes of two leading stock exchange markets in Africa during the 1995-2015 periods. Results showed mixed effects of most ICT metrics and moderating variables in the study. Specifically, the effect of mobile telephone on all market indicators was positive and significant. Further, aggregate effect of the ICT proxies and moderating variables on all market indices was statistically significant. The ICT proxies accounted for positive dynamics in market outcomes, market operations and, thus, sine quo non to growth and development of the markets and financial sectors in the Continent. Therefore, more investments in ICT wares and innovation by the stock exchanges and financial sectors in Africa were recommended.

Keywords: ICT proxies; Market indices; Gompertz curve; Functional models; Sub-Saharan Africa

JEL Classification: C12; C23; D53; E43; G23; O55

1. Introduction

Information and communication technology (ICT) has affected virtually every aspect of human activities and interactions in recent times. In Africa and the world over, ICT has tremendously affected financial market operations. ICT has enhanced the liquidity, efficiency and competitiveness of the markets; and fostered the need for regional cooperation, integration and cross-border listings of stock markets in Africa. Irving (2005) noted that a well implemented regional cooperation and, at a later stage, integration, holds more benefits by way of cross-border listings, technology and information sharing. This, among others, underscores the relevance

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of ICT in operations of the stock exchanges in particular and the financial markets in general. Johannesburg Stock Exchange (JSE) and the Nigerian Stock Exchange (NSE) have similarities in terms of reforms timings and innovations. For instance, the exchanges went through significant reforms in the 1990s, which culminated to unrestricted foreign interests in locally quoted companies; and replacement of open outcry trading system with fully automated trading system. Recently, both exchanges have undergone further restructuring and reformation, which include moves to electronic system, amendments of listing requirements and existing laws relating to capital market as well as market segmentation (Irving, 2005; Ezirim et al., 2009; Obiakor & Okwu, 2011; Onyema, 2013a). At one time or the other, foreign investment inflows to the exchanges increased substantially. However, while the exchanges have benefited from the inflows, each has become more vulnerable to external shocks induced by volatility in international financial markets. For example, while the JSE's overall share index fell by 30 percent in August 1998 owing to the financial crises in Russia and Brazil in 1998 (Irving, 2005), the NSE crashed ten years after owing to the global financial meltdown of 2007/2008 (Okwu & Obiakor, 2011). The NSE and JSE were among the top performing exchanges globally in 2012 (Onyema, 2013b; Okwu, 2015).

Since 2002, trading on the JSE has been carried out via its Stock Exchange Electronic Trading Services (JSE SETS) - a version of the London Stock Exchange's SETS technology tailored specifically for the needs of the JSE under a business agreement between the two exchanges (Irving, 2005). In December 2003, the JSE launched its Alternative Exchange (AltX) as a specialised tier for high-growth potential SMEs. Similarly, the NSE recently segmented its market in a bid to streamline the markets and industry sectors, conform to global standards and introduced market capitalisation and stock classifications to drive deeper understanding and inform investor portfolio construction (NSE, 2011). The NSE's ASeM is the counterpart of JSE's AltX. In 2012, the NSE executed a number of key strategic initiatives, among which were Primary Market Making, a suite of value-added services (*X-Value*), and investment in two trading plating platforms (Onyema, 2013a). Interestingly, while JSE which was set up in 1887 is sub-Saharan Africa's oldest stock market and, according to Irving (2005), the most highly developed in sub-Saharan Africa, the NSE which was founded in 1961/1977 is poised to champion the acceleration of Africa's economic development, and to become "The Gateway to African Markets" (NSE, 2011). Obviously, the processes and outcomes must be measurable using relevant indicators. The working proposition was that ICT had no significant impacts on market outcomes both in specific and aggregate levels. The paper has five sections. Section two which is the review of relevant literature comes after the introduction. Methodology of the paper is discussed in section three. Data are analysed and discussed in section four. Conclusion and recommendations are done in section five.

2. Literature Review

2.1. Conceptual Issues

ICT is an umbrella term that includes any communication device or application like radio, television, cellular phones, computer and network hardware and software. Others are satellite systems and devices associated with them such as videoconferencing and distance learning. ICT is about the application of computers, telecommunications equipment and infrastructure to generate, process, store, retrieve, transmit and manipulate data or information in the context of business or other transactions. It falls within the framework of computer wares, networks and other information dissemination channels like television, radios and telephones. Several industries like computer hardware, software, electronics, semiconductors, Internet service providers, telecommunications equipment, e-commerce and computer services are associated with the ICT concept (Chandler & Munday, 2012). The business value of ICT is to automate business process: provide information for decision making, connect businesses with their customers or clients, and render flow of services to increase efficiency and productivity (Hossein, Fatemeh & Seyed, 2013). Global economy has been fuelled by a greater assimilation of world markets and impressive growth of ICTs (Bhunja, 2011). Computer-facilitated trading processes have increased short-term price volatility and risks even as the stock markets become excessively volatile, and very few investors can have access to Central Securities Clearing System (CSCS) and online trading system (Shiller, 1989; Summers, 1988; Porteba, 1988) as in Ezirim et al. (2009). The markets are expected to leverage on ICT accelerate economic activities via domestic savings, quantity and quality of investment (Hossein et al., 2013). This has some implications for market outcomes of the stock exchanges. Stock exchanges are the markets where firms and governments can raise long-term capitals for productive ventures. It is a network of specialised financial institutions which brings together suppliers and users of long-term capital fund (Ologunde, Elumilade & Asaolu, 2006). They serve to reduce investment risk (<http://www.businessdictionary.com/definition/stock-exchange.html>). Information technology necessitates changes in the way transactions are negotiated, executed and settled (Mohanney, 1997). ICT infrastructure in the exchanges involves four essential elements – dematerialization, e-trading, centralised trade processing and centralised clearing and settlement (World Federation of Exchanges, 2014). In this paper, stock exchange market is considered as an ICT-driven regulated mechanism through which providers and users of new long-term funds interface and existing financial securities are traded at market prices. The concept of ICT-stock market-outcome nexus is illustrated in figure below.

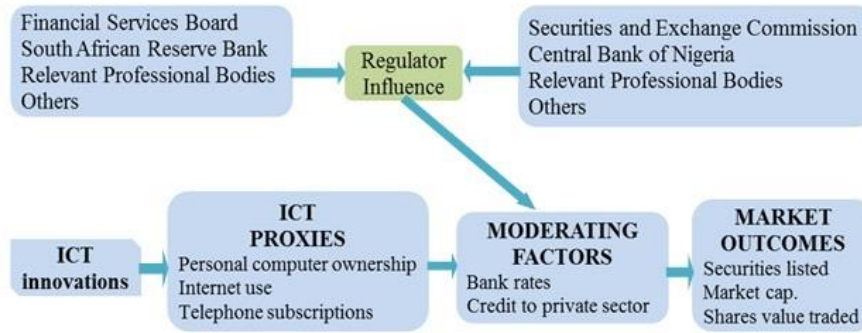


Figure 1. ICT-Stock-Market-Outcome Nexus

Source: Own Conceptual Model (2016)

The model shows that ICT innovations transmit through the proxies (personal computer ownership, Internet use, and telephone subscriptions), with deposit and lending rates of banks and market capitalisation relative to size of the economy exerting moderating exogenous influences, to ultimately influence the outcomes (securities listed, market capitalisation and shares value traded) of the stock exchange markets. Analytical equations emanate from the conceptual model. Most of available studies have not specifically examined ICT in relation to stock market outcomes in Africa (Oyelere & Kuruppu, 2012; Mihasonirina & Kangni, 2011; Bankole et al., 2010; Ezirim et al., 2009).

2.2. Theoretical and Empirical Review

The development, application and spread of ICT have motivated some studies in attempts to test and validate relevant theories for better understanding of the diffusion and use of ICT (Richardson, 2009; Yi et al., 2006; Venkatesh et al., 2003, Rogers, 2003). ICT-induced efficiency of the stock exchanges, measured in terms of market outcomes, is the driving curiosity for this paper. Therefore, theoretical underpinning in this paper is the Roger’s (2003) innovation diffusion model. The model has been applied in many disciplines, and researchers who study the adoption of innovations often use it to explain the technology innovation process (Oliver & Goerke, 2008; Tabata & Johnsrud, 2008). The model has effectively been used in various studies in such areas as sociology, communications, economics, marketing and technology (Meyer, 2004). The idea in this paper is that stock market operators, participants and other stakeholders are among the adopters of technology innovation, adoption and use. Efficiency and the desire for optimality in market outcomes are the core drivers of the choice to innovate, adopt and apply ICT in activities of the stock markets.

Venturini (2008) examined the impact of digital capital on GDP growth in the United States and the European Union 15 (EU-15), and found that ICT capital significantly spurs GDP growth in the long-run. Esteban & Navarro (2011) found that the economies of the European Union 27 (EU-27) countries have achieved different levels of productivity, economic and human capital development owing to ICT use. Zagorchev et al. (2011) studied the dynamic relationship among financial development, ICT and per capita GDP in a sample of 86 countries, and found that ICT and per capita GDP increase liquidity, size and activity of the financial systems. Shahram (2014) examined the relationship between ICT diffusion and economic growth in Russia, and showed that new industries emerge as a result of the spread of ICT. Menzie and Fairlie (2010) investigated the determinants of cross-country disparities in personal computer and Internet penetration in developed and developing countries, and found disparities in income, telephone density, legal quality, and human capital to be among the main factors responsible for low rates of technology penetration in developing countries.

Hosseini, Fatemeh and Seyed (2013) studied the impact of ICT development on stock market development in the world's leading capital markets, and found that some market indices had direct relationship with the ICT use. Kehbama (2005) examined the role of ICT in the economic development of South Africa, and found that ICT has both positive and negative contributions to developmental changes. Bankole, Irwin and Osei-Bryson (2010) studied the impact of ICT on trade in Africa, with emphasis on intra-regional trade and economic development. They found ICT infrastructure to be the launch pad that landlocked countries in Africa need to develop knowledge-based economies. Adejola (2011) analysed the impact of ICT on earnings of selected banks in Nigeria. The results showed that while contributions of ICT to profitability of the banks were not significant, the contributions to other assets were significant.

3. Methodology

3.1. Study Design, Data Sources, Hypotheses and Analytical Framework

Pooled data were used to examine the ICT-stock-exchange market nexus in Africa. ICT and market indices were sourced from the World Bank's World Databases, Annual Reports of the stock exchanges, United Nations Conference on Trade and Development (UNCTAD, 2014), Development Indicators of South Africa, Central Bank of Nigeria Annual Reports among others. Some data sets were derived. Market indices were securities listed on the exchanges (SLEs), market capitalisation (MCAP), shares value traded (SVT) and market capitalisation-GDP ratio (RMCAP) - stock market relevance. ICT proxies were personal computer ownership (PCO), Internet use (IU), fixed and mobile telephone subscriptions (FMTS). Bank deposit rates (BDR), bank lending rates (BLR), and credit to private sector-GDP ratio

(RCPS) were taken to be moderating variables. No oversight of the inverse relationship between bank rate and stock market returns. Hypotheses tested were: H₀₁: Use of ICT did not significantly affect securities listings on the stock exchange markets. H₀₂: Use of ICT did not significantly affect capitalisation of the stock exchange markets. H₀₃: ICT use had no significant effects on shares value traded on the stock exchange markets. H₀₄: ICT did not significantly account for size of the economies. To test the hypotheses, estimated coefficients of the analytical models were evaluated at the conventional 5% level of significance. Analytical framework adapted was the model suggested by Chow (1967, 1983) for technology diffusion, which was modified by Rogers (2003). The model assumes that the use of technology tends to an equilibrium level over time along an S-shaped path. Chow specified the model as: $\log \eta_{i,t} - \log \eta_{i,t-1} = \theta_{i,t} [\log \eta_{i,t}^* - \log \eta_{i,t-1}]$ where $\eta_{i,t}$ is ICT in country [stock exchange market] i during time period t , $\eta_{i,t-1}$ is ICT usage in country [stock exchange market] i in the immediate preceding time period, $t-1$, $\eta_{i,t}^*$ is post-diffusion [use] equilibrium level in country [stock exchange market] i during time period t , $\theta_{i,t}$ is the speed of adjustment in country [stock exchange market] i during time period t .

ICT is the dependent variable; factors that cause changes in ICT use are the independent variables. Thus, the model expresses ICT variable as responding to the determinants of its intensity of use. But in this paper, stock market outcomes are treated as responding to dynamics in ICT proxies. This necessitated adapting the model for this paper. For convenience, we juxtaposed η with Z . Thus, the model become: $\log Z_{i,t} - \log Z_{i,t-1} = \theta_{i,t} [\log Z_{i,t}^* - \log Z_{i,t-1}] \dots\dots\dots (1)$

where $Z_{i,t}$ is ICT use in stock exchange market i during time period t , $Z_{i,t-1}$ is ICT use in stock exchange market i during the immediate preceding time period $t-1$, $Z_{i,t}^*$ is post-ICT use equilibrium for market outcomes of stock exchange market i , $\theta_{i,t}$ depicts speed of adjustment to equilibrium outcomes in stock exchange market i .

Next, we substituted the market outcome and ICT proxies as the dependent and independent variables, respectively. We also introduced autonomous component, β_0 , sensitivity coefficient, α_1 , and stochastic term, μ , such that we specified a variant of the model as: $\log SMO_{i,t} - \log SMO_{i,t-1} = \beta_0 + \alpha_1 ICT_{Use_{i,t}} + \mu \dots\dots\dots (2)$

where $\log SMO_{i,t} - \log SMO_{i,t-1}$ is one period-lagged value in market outcomes responding to ICT use by the respective stock exchange markets. $ICT_{Use_{i,t}}$ comprises the proxies of ICT use in the respective stock exchange markets during the time periods. The autonomous component, β_0 , is the measure of market outcome without the use of ICT. The sensitivity coefficient, α_1 , aggregates the effects of ICT use on market outcomes. It indicates the direction and magnitude of the effects of ICT use on market outcomes. Therefore, it is a measure of how the proxies for market

outcome respond to changes ICT use by the stock exchange markets. The stochastic variable, μ , accommodates the influences of other factors that determine market outcomes of the exchanges but which we have not identified and directly included in the model. However, given changes in market outcomes as implied in equation (2), we introduce same in the equation for ICT use as well as the influences of the moderating variables (MV). Accordingly, we transform equation as follows:

$$\Delta SMO_{k,i,t} = \Delta[\beta_0 + \alpha_{k,i,t} \sum_{p=1}^3 ICT_{Use_{k,i,t}} + \beta_{k,i,t} \sum_{m=1}^3 MV_{k,i,t} + \mu] \dots\dots\dots (3)$$

Given that the autonomous component, β_0 , is constant but the effects indicated by the sensitivity coefficients, α_k and β_k , vary over time; and considering the property of zero variance assumption about μ over time, equation (3) becomes:

$$\Delta SMO_{k,i,t} = \beta_0 + \alpha_{k,i,t} \Delta \sum_{p=1}^3 ICT_{Use_{k,i,t}} + \beta_{k,i,t} \Delta \sum_{m=1}^3 MV_{k,i,t} + \mu \dots\dots\dots (4)$$

where $\Delta SMO_{k,i,t}$ is change stock in outcome of stock market, k , in country i during time period t , $\Delta \sum_{p=1}^3 ICT_{Use_{k,i,t}}$ and $\Delta \sum_{m=1}^3 MV_{k,i,t}$ respectively are matrices of changes

in ICT use proxies, p , and the moderating variables, m , $\alpha_{k,i,t}$ and $\beta_{k,i,t}$ respectively are the sensitivity coefficients (size of the effects) of changes in ICT use on outcome of stock exchange market, k , for country i , during time period t , β_0 is the model intercept, and μ is the model error term. k and i are merely identifier descriptors.

By implication, changes in market outcomes over time depend on changes in ICT use as well as the moderating variables, given the long-run mean value β_0 and error term μ . However, since observed values of the variables that made up the data sets were taken at specific points in time, we ignored the dynamism of equation (4), and assumed a static composite model. Consequently, equation (4) becomes:

$$SMO_{k,i,t} = \beta_0 + \alpha_{k,i,t} \sum_{p=1}^3 ICT_{Use_{k,i,t}} + \beta_{k,i,t} \sum_{m=1}^3 MV_{k,i,t} + \mu] \dots\dots\dots (5)$$

Within a panel data environment, we disaggregated equation (5) to enable us determine the partial and overall effects of the ICT use proxies as well as the moderating variables on each of the indicators of the stock exchange markets outcomes. We deduced the following models for analysis in this paper:

$$SLES_{i,t} = \alpha_0 + \alpha_1 PCO_{i,t} + \alpha_2 IU_{i,t} + \alpha_3 FMTS_{i,t} + \alpha_4 BDR_{i,t} + \alpha_5 BLR_{i,t} + \alpha_6 RCPS_{i,t} + u_{i,t} \dots\dots\dots \text{Model 1}$$

$$MCAP_{i,t} = \beta_0 + \beta_1 PCO_{i,t} + \beta_2 IU_{i,t} + \beta_3 FMTS_{i,t} + \beta_4 BDR_{i,t} + \beta_5 BLR_{i,t} + \beta_6 RCPS_{i,t} + u_{i,t} \dots\dots\dots \text{Model 2}$$

$$SVT_{i,t} = \theta_0 + \theta_1 PCO_{i,t} + \theta_2 IU_{i,t} + \theta_3 FMST_{i,t} + \theta_4 BDR_{i,t} + \theta_5 BLR_{i,t} + \theta_6 RCPS_{i,t} + u_{i,t} \dots \dots \dots \text{Model 3}$$

$$RMCAP_{i,t} = \lambda_0 + \lambda_1 PCO_{i,t} + \lambda_2 IU_{i,t} + \lambda_3 FMST_{i,t} + \lambda_4 BDR_{i,t} + \lambda_5 BLR_{i,t} + \lambda_6 RCPS_{i,t} + u_{i,t} \dots \dots \dots \text{Model 4}$$

where *SLEs*, *MCAP*, *SVT* and *RMCAP* are stock market outcome (*SMO_{k,i,t}*) indices; *PCO*, *IU*, *FMST* are proxies for ICT use; *BDR*, *CLR* and *RCPS* are moderating variables (MV). Each is as previously defined. The subscripts *i* and *t*, are the identifier descriptors for the respective stock exchange markets and time periods respectively. $\alpha_0, \beta_0, \theta_0$, and λ_0 , respectively, are intercepts of the respective models. The sensitivity coefficients $\alpha_i, \beta_i, \theta_i$, and λ_i , and (*i* = 1, 2, 3) depict the size and direction of the effects of ICT use as well as the moderating variables on stock market outcomes (*SMO_{k,i,t}*); $\mu_{i,t}$ (*i* = 1, 2; *t* = 1, 2, 3, ..., 20) are model error terms for possible disturbances from assumed normal behaviour.

Given a normal investment behaviour on the part of investors in the stock markets, we expected outcomes of the markets (*SMO_{k,i,t}*) to respond positively to the proxies of ICT use as well as RCPS, but negatively to BDR and BLR, respectively. Such disaggregated models have been previously employed (Okwu, 2015; Adesola et al., 2013; Bhunia et al., 2011; Obiakor and Okwu, 2011; Ezirim, 2009; Choi & Cook, 2005).

4. Results and Discussion

Table 1. Partial Correlation Coefficients

SLEs	MCAP	SVT	RMCAP	PCO	IU	FMST	BDR	BLR	RCPS	
SLEs	1									
MCAP	0.3483	1								
SVT	0.1773	0.9369	1							
RMCAP	0.6362	0.8808	0.7441	1						
PCO	0.6144	0.8857	0.8406	0.9073	1					
IU	-0.1871	0.4573	0.4608	0.1671	0.2620	1				
FMST	-0.0383	0.8048	0.8400	0.5234	0.6193	0.8546	1			
BDR	0.0610	-0.5467	-0.5382	-0.3945	-0.4278	-0.6590	-0.4013	1		
BLR	-0.2214	-0.7718	-0.7373	-0.6704	-0.7116	-0.6064	-0.5845	0.8896	1	
RCPS	0.6586	0.8029	0.7252	0.8826	0.9100	0.1844	0.6665	-0.3710	-0.6414	1

Source: Own computations using EViews8

SLEs had positive correlations with PCO, BDR and RCPS; but negative correlations with IU, FMST and BLR. MCAP had positive correlations with PCO, IU, FMST and

RCPS; but negative correlations with BDR and BLR. SVT and RMCAP had positive correlations with PCO, IU, FMTS and RCPS; but negative correlations with BDR and BLR. There were more positive among the market outcome and ICT proxies; but more negative correlations among the market indices moderating variables. Pairwise ICT proxies were not highly linearly correlated – coefficient exceeded (Agun, 2009; Iyoha, 2004) or showed squared value in excess of 0.80 (Kennedy, 2008). Thus, the data series were appropriate for cause-and-effect regression analysis.

Table 2. ICT and Operational Outcomes of the Stock Exchange Markets

Method: Panel Least Squares Sample: 1990 2015 Periods Included: 26
 Cross-Sections Included: 2 Total Panel (Balanced) Observations: 50

Operational Outcomes of the Stock Exchange Markets						
	Model 1		Model 2		Model 3	Model 4
	Dept.	Var:	Dept.	Var:	Dept. Var:	Dept. Var:
	Log(SLEs)		Log(MCAP)		Log(STV)	Log(RMCAP)
ICT Proxies	Coefficient		Coefficient		Coefficient	Coefficient
	(α_i)		(β_i)		(θ_i)	(λ_i)
PCO	0.4831 (0.1251)**		1.5127 (0.3125)**		2.4063 (0.4018)	0.8975 (0.2574)**
IU	-0.0784 (0.0639)		0.0215 (0.1582)		0.3264 (0.2204)	-0.0698 (0.1315)
FMTS	0.0624 (0.0282)**		0.0969 (0.0333)**		0.3598 (0.1516)**	0.1452 (0.0068)**
BDR	-0.2940 (0.2539)		0.3503 (0.6724)		-0.1923 (1.1151)**	0.3118 (0.5222)
BLR	1.8158 (0.2677)**		0.4967 (1.1122)		2.5280 (0.7062)	0.4175 (0.5506)
RCPS	0.1524 (0.00607)		0.1807 (0.2617)**		-0.5076 (0.3387)	0.1108 (0.2147)
	Adjst. R ² = 0.7876 F-stat = 26.9558** DW-Stat = 1.9534		Adjst. R ² = 0.8932 F-stat = 59.5254** DW-Stat = 1.8203		Adjst. R ² = 0.8914 F-stat = 49.2551** DW-Stat = 1.7423	Adjst. R ² = 0.8553 F-stat = 41.3078** DW-Stat = 1.8844

Standard errors (SEs) are in parentheses. **Significant at 5%; p-value < 0.05.

PCO had significant positive effects on market outcomes, except shares values traded on which it had positive but not significant effect as evidenced by the respective standard errors (SEs) which are less than half of the associated coefficients. IU had positive but not significant effects on MCAP and SVT; negative and insignificant effect SLEs and RMCAP, as proved by the SEs relative to the

associated coefficients. FMTS had significant positive effect on all market indices, as evidenced by significance of the positive coefficients and SEs. This suggests negligible use of the Internet for stock market activities by investors, and that equity holders' indirect participation in the stock market through stockbrokers. The SEs proved that BDR had positive but not significant effects on MCAP and RMCAP, respectively; insignificant negative effect on SLEs, significant negative effect on STV. BLR had positive and significant effect on SLEs, but insignificant positive effects on MCAP, STV and RMCAP, respectively. RCPS had significant positive effect on MCAP; but insignificant positive effects on SLEs and RMCAP, respectively. The effect on STV was negative and insignificant. ICT use had mixed effects on market outcomes of exchanges during the 1990-2015 periods. Similarly, the moderating factors (BDR, BLR and RCPS) had somehow mixed effects. The ICT proxies and the moderating factors jointly had significant effect on the each of the market outcome indices at the 5% level of significance, as shown by F-statistics of 26.9558, 59.5254, 49.2551 and 41.3078 for the respective models. The independent variables explained high variations in market outcomes, as shown the adjusted R² values of 0.7876, 0.8932, 0.8914 and 0.8553, respectively. They explained approximately 79%, 89%, 89% and 86% of the total variations in the market outcome indices, respectively. The Durbin-Watson statistic values of 1.9534, 1.8202, 1.7423 and 1.8844 provided empirical evidences that the independent variables were not highly linearly correlated and, thus, free from the problem of serial autocorrelation.

5. Summary, Conclusion and Recommendations

This paper has analysed the effects of some ICT proxies on operational outcomes of the leading stock exchange markets in Africa, Johannesburg and Nigerian Stock Exchanges (JSE and NSE). The analysis showed that the moderating factors had mixed effects on the market indices considered in this paper. FMTS positively affected all market indices. PCO positively affected most market indices. The reverse was the case for the moderating variables. However, ICT and moderating variables had overall significant effects on and strongly explained variations in explaining variations in, each of the market index. Thus, the paper concludes that use of ICT has significantly improved performance outcome of the two stock exchange markets and, by extension the stock exchange markets in Africa and, therefore, is *sine quo non* to the growth and development of Africa's stock exchange markets in particular and financial sectors in general. Therefore, the paper recommends more investments in ICT wares, innovations and use need to be considered by all relevant authorities in stock exchange markets and financial sectors in Africa.

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