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ICT Adoption, Competition and Innovation of Informal Firms in West Africa: Comparative Study of Ghana and Nigeria [1]

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Abstract

Purpose – This study investigates how ICT adoption enhances the innovativeness of informal firms in West Africa, using the cases of Ghana and Nigeria.

Design/methods/approach – The study used the World Bank Enterprise Survey data 2014 for Ghana and Nigeria with binary logistic regression analysis to achieve this. Four different innovations are modelled. They include: first, whether a firm has innovated based on producing a new product or significantly improved product; second, whether a firm has innovated in its methods of production or services; third, whether a firm has innovated in terms of its organisational structure; and fourth, whether a firm has introduced a new and improved marketing method.

Findings – The results show that the use of email, cellphone and website has a positive impact on the four types of innovations modelled. However, these effects varied markedly between Ghana and Nigeria. Firms' spending on R&D, firm giving its employees the chance to develop their ideas and when firm competes with others; all positively impact on the four types of innovations. Thus, the study recommends that policies should be geared towards making firm have more access to ICTs to enable them to be more innovative to serve clients and the economy.

Originality/value – This study differs by concentrating on how the adoption of ICTs could help firms to introduce innovations into their companies in two West African countries, namely: Ghana and Nigeria. Thus, it complements literature on informal firms' innovation efforts in West Africa.

JEL Codes: D21, L60, L80, O14, O30
Keywords: Firms, ICT adoption, Innovation, West Africa, World Bank Enterprise Survey data, Ghana, Nigeria.

1. Introduction

Historically, extant studies on the growth or productivity of firms and the economy have concentrated on the issues of the combinations of labour-capital factors of production. Interest in the study of factors that affect economic growth and development, besides capital accumulation or savings are traceable to the development of endogenous growth theory (Romer, 1994; Uzawa, 1965). Innovation, competition and knowledge creation gained centre interest in the analysis of economic development (Aghion & Howitt, 1998; Lucas, 1998) afterwards. There have been some empirical studies on the role of technology/innovation and productivity in industry growth and development. Some scholars have concluded that Research and Development (R&D) spending by firms have a more significant impact on productivity (Cuneo & Mairesse, 1983; Gawer, 2014; Grilliches & Mairesse, 1982; Tsai & Wang, 2004; Wakelin, 2000) and employment growth (Harrison *et al.*, 2014).

At the national and regional levels, many scholars have studied the impact of innovation on economic growth and development (Ejemeyovwi *et al.*,2018; 2019; Ejemeyovwi & Osabuohien, 2020; Nelson, 1992; Nelson & Rosenberg, 1993; Verspagen, 1995). Redmond (2004) concluded that competition forces a firm to innovate (mainly, product innovation). The Australian Bureau of Statistics (2008) indicated that Australian firms that innovate are two times more likely to achieve increased productivity and 63 per cent chance realising increased profitability than their counterparts. Firms' innovation can take any twist. It can include discovering new sales regions, developing new products, using new ways of doing business, attaining reputation, or turn, that is responding to pressures from other firms in the market, and responding to government regulations. Many firms could have innovated, but the enabling environment or tools to help innovate are not available. Barsh, Capozzi & Davidson (2008) indicated that innovation is one of the top drivers of the growth and development of firms. However, most firms cannot stimulate innovation. ICTs could offer the platform to help firms innovate. ICTs operate as an enabling factor for businesses to innovate and improve their performance, serving as a general-purpose technology (Bresnahan & Trajtenberg, 1995). Hempell (2002) noted that the firm's previous innovation performance might help determine the potential use of ICT by such firm. Also, Polder *et al.* (2009) extend the Crepón-Duguet-Mairesse – CDM model by the inclusion of ICT in the model as an enabler of innovation. They concluded that ICT is an essential driver of innovation in both manufacturing and services. Hall, Lotti, and

Mairesse (2012) use an augmented CDM in which they treat ICT in parallel with R&D as an input to innovation rather than merely an input of the production function.

Many other researchers (e.g. Blundell, Griffith & Van Reenen, 1999; Kilponen & Santavirta, 2007; Tishler & Milstein, 2009) have looked at how firm innovation is affected by competition in the industry and have generalised the finding that innovation increases with the presence of competition. The nature of the association between innovation and firm productivity has seen much empirical work but with many more overseas studies than Sub Sahara Africa (SSA) firms. It is partly because of Africa lacks data on firm innovation, unlike the Community Innovation Survey (CIS) in Europe. Many aspects of the literature examined how competition drives firm innovation (Aghion *et al.*, 2008; Artés, 2009; Beneito *et al.*, 2011); how R&D expenditure affects firms' innovation (Peroni, 2011; Polder & Veldhuizen, 2010); how firms' innovations affect productivity (Nickell, 1996); or how firms' innovation affect labour productivity (Bogliacino & Pianta, 2009). To the best of the authors' knowledge, there is no study on how ICTs adoption could foster the innovativeness of firms (especially informal firms) and thus stimulating productivity, especially in SSA.

Most innovations in SSA firms consist of incremental changes that have little or no impact on international markets. They are mostly based on imitation and technology transfer (e.g., acquisition of machinery and equipment and disembodied technology) (Ernst 2007; Mytelka 2000; Oyelaran-Oyeyinka, Laditan, & Esubiyi, 1996). Dana (2007) acknowledged that lack of literacy and other skills among the labour force, lack of managerial skills, lack of access to technology, lack of access to capital, along with poor infrastructure (road maintenance), and others. Some empirical studies have focused on the specific relevance of innovations and organisational changes involved by applications of ICT within firms (Aboal & Tacsir, 2015; Bresnahan & Greenstein, 1996; Brynjolfsson & Hitt, 2000). However, these studies focused on advanced economies rather than SSA economies. Also, earlier studies focus on understanding the link between ICT and productivity (Aboal & Tacsir, 2015), ICTs and services patronage (Karakara & Osabuohien, 2019; Osabuohien & Karakara, 2018). This current study considers informal firms in SSA, mainly from Ghana and Nigeria. These firms (informal) are considered in this study for two reasons; first informal firms (mostly SMEs, especially in Africa) lack the capacity to innovate, and yet they compete with other firms that may have R&D and technology absorption capacities. Madichie *et al.,* (2019) found that public funding for SMEs technology

acquisition has a negative and significant impact, perhaps suggesting the complexity of debt financing and the exorbitant interest rates charged on principals borrowed by foreign nationals. Second, evidence abounds that SMEs could use ICTs to grow and be more innovative (European Commission, 2008), which is coupled with the issue that ICT adoption and its usage vary between firms within the same industry or even same country (Bertschek & Fryges, 2002). It may be due to the argument that small businesses have less money and, therefore, less to invest in ICT (Gërguri-Rashiti, Abazi-Alili, & Ramadani, 2013).

Thus, this paper analyses how ICT adoption by firms could foster their quest to innovate and compete in the industry they find themselves. The study compared firms in Ghana and those in Nigeria to tease out whether there are differences in how ICTs affect the innovativeness of firms in these countries. This study is germane, giving the fact that African countries are less competitive. The global competitive index ranked Ghana 111 and Nigeria 127 out of 144 countries in 2014. It is, therefore, crucial that measures are taken to help make firms in SSA competitive in their operations. This study is structured as follows; section two presents insights from the analytical framework and empirical literature. Section three captures the data and methods of analysis, while section four gives the results and discussion and the last section concludes with some implications.

2. Theoretical underpinnings and Analytical framework and literature review

2.1 Theoretical underpinnings

There are theoretical studies on firm innovation and productivity or growth. In one stand, some studies advocate the use of market share or market power of a firm to measure how firm innovates. Early scholars on innovation and productivity, has shown that concentrated market structures are likely to influence the levels of innovation in a firm. It is so because market concentration provides early enters (i.e. firms that enters the market first) with both the means (e.g. finance strength and knowledge of the market) and the incentive to innovate. However, in the case of a monopoly, Arrow (1959) asserted that a monopolist firm might be less innovative because it gives up the opportunity to continue to earn monopoly profits it could enjoy without innovating. Another theoretical proposition relates to competition and innovation relationship as having an inverted U-shape. Howitt (2004) predicts that firms can earn lots of profit without having to innovate if they happen to find themselves in industries where there is little

competition. Aghion (2006) noted that this relationship between competition and innovation has a behavioural base. Firms may not innovate if they are in an industry that is totally competition free. The author was quick to add that too much competition does not encourage innovation.

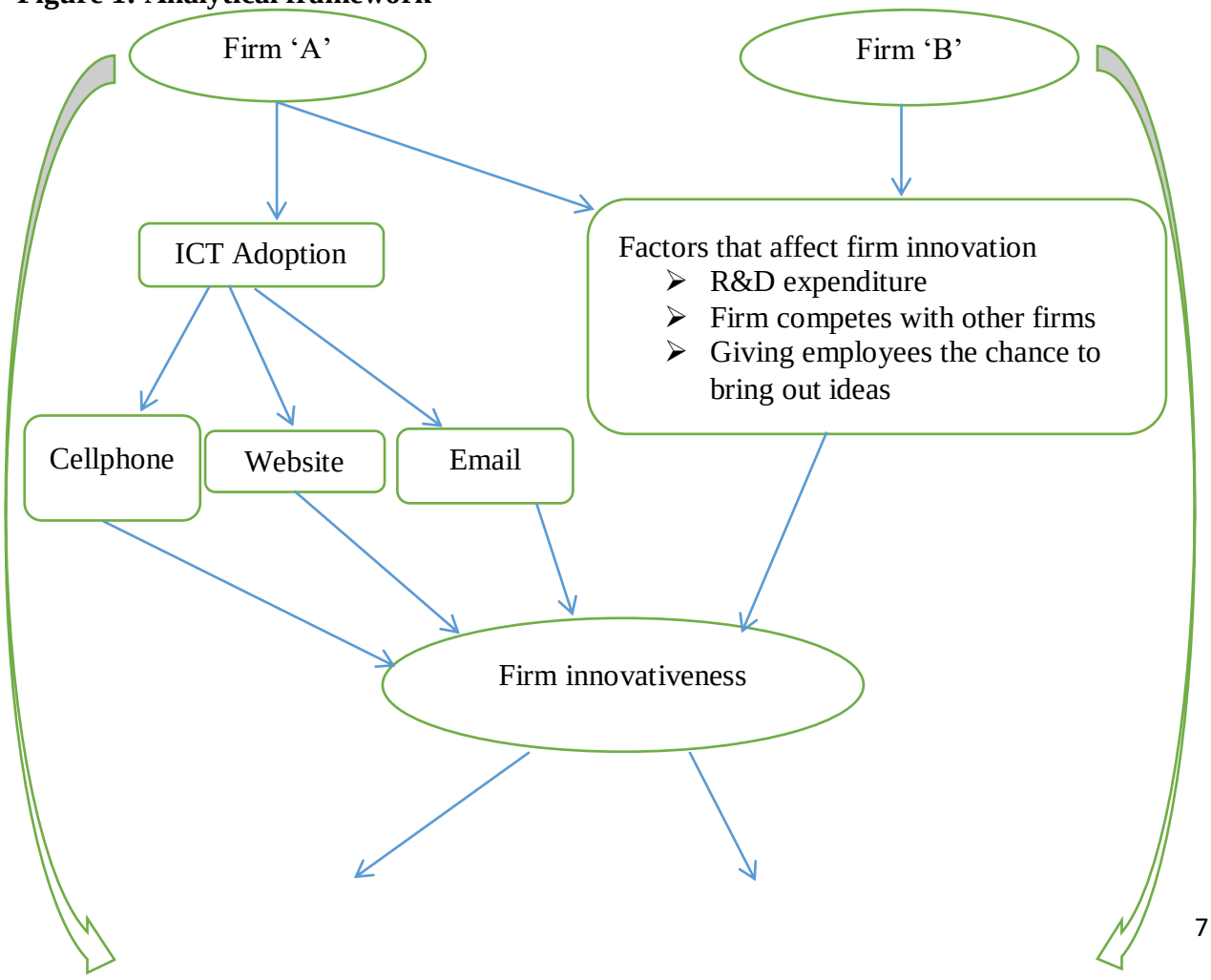
Theoretically, other studies looked at the size of the firm and the innovation of the firm. Some scholars have studied the relationship between firm size and innovation performance. Schumpeter (1942) asserted that firms with market power could easily be innovative because these firms can easily accumulate the resources necessary to invest in innovative activity. Ahn (2002) noted that large firms might be strong enough to carry on the commercialisation of their innovations, they may also enjoy economies of scale and scope in being innovative; and large firms may have better access to external finance. However, Scherer (1992) concluded that studies have proven that the weight of the existing statistical evidence goes against Schumpeter's 1942 argument that being large as a firm encourages or is an engine for technological innovation. There are varieties of different measures of innovations as studied by different scholars. These include firm R&D spending, patenting, number of innovations, and firm total factor productivity (TFP). Each of these measures is subject to its limitations. For example, the ability to patent an innovation varies across firms and industries, and the distribution of patents' economic benefit is not even. Also, innovation counts are difficult to obtain, innovations show variability in quality, and requires subjectivity definition in choosing what to count.

2.2 Analytical framework

Figure 1 explains the analytical framework for this study. The framework hypothesises that firms that adopt ICTs in their operations will be more likely to be innovative than firms that do not adopt ICTs. Thus, ICT adoption supports the innovation efforts of firms. In the figure, firm 'A' and 'B' are similar firms in the same industry. Both firms spend on R&D, compete with others and give their employees the chance to bring ideas onboard. The only difference is that firm 'A' adopts ICTs (Cellphone, website, emails) in its operations while firm 'B' does not. This paper hypothesises that firm 'A' is more likely to be innovative compared to firm 'B'. With the use of ICTs, firm 'A' could easily be more process innovative. Firm 'A' could use these ICTs to easily introduce significantly improved marketing methods to reach out to larger customers than firm 'B'.

The figure further shows that firm 'A' could reduce the time effort in its production and distribution process of its goods and or services. The firm (firm 'A') could easily advertise on its website, contact customers and suppliers with email or cellphone and even make internal employee communication better to help reduce time in production and distribution of its products. The paper acknowledges that both firms could have the same product innovation level. This is because they both spend on R&D, are in a competitive market that forces them to innovate, and they both give their employees the chance to bring on-board their ideas. R&D expending would allow the firm to come out with new products or new methods of production. Also, competition pushes firms to innovate in order to be relevant in the industry. This paper argues that ICTs adoption could enhance this innovativeness of firms. It was earlier hypothesised by Gërguri-Rashiti *et al.*, (2017) that in transition economies, ICT represents the way businesses communicate and conduct activities in the global marketplace. Thus, as more firms focus on the relationship between their innovative capabilities and ICT strategies, managers must encourage an atmosphere that is conducive to innovation.

Figure 1: Analytical framework



Source: The Authors'

2.3. Brief Insights from Empirical literature

Many researchers have looked at firm innovation activities and how that relates to productivity and growth. Bogliacino and Pianta (2009) studied eight major European countries using a structural model to look at how diverse technologies could contribute to growth in labour productivity. Also, Moreno and Surinach (2014) focused on verifying the relationshipsbetween innovating, innovation adoption and productivity growth. They paid attention to the diffusion of innovation within the firm. They found that countries, where productivity decreases, there is lower growth in innovation adoption and countries with high productivity, have a mixture of lower innovation adoption and some higher innovation adoption. Firm innovation could be affected by how the firm adopts ICTs. There have been some studies on ICTs enhancement of firm innovation. Most of these studies concentrate on developed countries.

Bresnahan and Greenstein (1996) argue that co-inventions in ICT-using firms involve high adjustment costs and uncertainties that may differ substantially between firms. Similarly, Brynjolfsson and Hitt (2000) point out that there are high costs and complementary efforts, e.g. due to complementary organisational changes, that are entailed by an efficient implementation of ICT. These adjustment costs often exceed the costs of ICT investments and may help explain the apparent excess returns that various empirical studies have found for ICT investments. Bresnahan *et al.,* (2002) and Brynjolfsson, Hitt and Yang (2002) reported evidence that the usage of ICT involves whole clusters of complementary efforts such as organisational changes, innovations and upgrading of the skills of the workforce simultaneously. The difficulty in introducing such clusters of arrangements simultaneously may explain both the varying ICT engagements by firms and the difficulty to copy apparent best practices from other firms.

Similarly, Hempell (2002) finds that complementary innovations are not enough for firms to attain productivity gains from ICT usage. The success of adopting ICT rather depends on a firm's long-term innovation strategy and its experience from past innovations in particular. For a representative sample of firms in German distribution and business-related services, Hempell

(2002) finds that firms that have introduced process innovations in the past have output elasticity for ICT capital that is four times as high as in firms without such experience.

Aboal and Tacsir (2015) observed that ICT is very relevant for innovation in manufacturing, especially for technological innovation. They added that the level of investment in ICT is only statistically significant for non-technological innovation. They again noted that the absence of ICT investment conspires against both technological and non-technological innovations. Also, Soames, Brunker and Talgaswatta (2011) investigated two meaningful relationships relating to firm behaviour and performance. They examined product market competition and innovation relationship as well as the association between innovation and productivity growth. Using discrete choice models (binary probit, ordered probit and multivariate probit models); they found that competition a firm face happens to be strongly associated with the likelihood of innovation activity. Higher market share, export status and size of the firm are positively related to being an innovator. For each of the innovation types studied, they concluded that the firm's productivity is likely to increase if it innovated. More so, Ramadani *et al.,* (2016) studied the impact of knowledge spillovers and innovation on firm-performance in the Balkans countries and indicated that innovative activities; knowledge spillovers; foreign ownership; and the proportion of skilled workers in the workforce all have a positive impact on firm performance.

Griffith, Harrison and Simpson (2006) studied European Union countries that have implemented the EU Single Market Programme (SMP). The SMP was associated with increased product market competition and with a subsequent increase in innovation intensity and productivity growth for manufacturing sectors. This was to encourage competition and innovation in firms and economic growth. They found that reforms that concentrate on the profitability of a firm lead to increased innovation, which could at least lead to increasing innovation intensity within the EU. They concluded that increased competition led to increment in firm R&D investment in manufacturing industries; hence this has led to product innovation in affected countries and industries.

Alder (2010) studied the relationship between innovation, competition and distance to the technology frontier, using enterprise surveys from 40 developing and transition countries. The author concluded that firms with more advanced technology compared to their main competitors are more products innovative and that innovation and competition are more positively correlated

at low levels of competition than at high levels. With some measures of competition, the correlation is highest at intermediate levels of competition, which suggests an inverted-U relationship. Also, the author asserted that competition is more correlated with product innovation when a firm is advanced (in terms of market share, educated workforce and R&D activities) than its main competitor. Also, Aghion *et al.*, (2008) using three different datasets, studied manufacturing firms in South Africa and concluded that consistently mark-ups are higher in South African industries than they are in corresponding industries worldwide. That profitability margins as computed from a sample of listed firms, are more than twice as large in South Africa than in other countries on average. The authors concluded that an inverted-U relationship exists between competition and growth. In this paper, a firm's innovation could be likened to the concept of grassroots innovation as espoused by Dana *et al.*, (2019). It posits that the success of grassroots innovation initiatives depends on the adoption of a socially-inclusive approach, in which activists, academics and government representatives permanently interact with the local community in every phase of project design and implementation. In this paper, a firm's innovation indicates the effort of a firm adopting ICTs, allowing employees to brainstorm on the innovative prospects and competing with others in the industry.

3. Data and Methodological Approach

3.1 Data

The World Bank's Informal Enterprise Survey (IFS) was collected in Ghana from 1st April to 11th May 2013. The data on non-registered business activities, "registration" is defined according to the established convention for the Enterprise Surveys in study countries, informal firms were defined as those not registered with the Registrar's General Department. The urban centres identified in Ghana were Accra, Tema, Takoradi, and North (i.e. Kumasi and Tamale). Each urban centre was divided into an appropriate number of zones, 180 zones were identified, and at least four interviews were completed per zone. A total of 729 interviews were completed in Ghana. An equal proportion of services and manufacturing (50:50) firms were interviewed. There were some missing observations in certain variables. So, we adjusted our number of observations from the 729 to 624 for the data for Ghana.

For Nigeria,the data was collected between April 2014 and February 2015 under, an initiative of the World Bank. Regional stratification for the Nigeria Enterprise Survey (ES) was

defined by 19 states: Abia, Abuja, Anambra, Cross River, Enugu, Gombe, Jigawa, Kaduna, Kano, Katsina, Kebbi, Kwara, Lagos, Nasarawa, Niger, Ogun, Oyo, Sokoto and Zamfara. The sample design for the Nigeria Enterprise Survey was generated to obtain interviews at 2640 establishments, and 2,272 were interviewed. The structure of the database reflects the fact that two different versions of the survey instrument were used for all registered establishments. The eligible manufacturing industries have been surveyed using the Manufacturing questionnaire (includes a standard set of core variables, plus manufacturing-specific questions). Eligible services have been covered using the Services questionnaire.

The data capture a binary response of whether the firms have innovated (i.e. introduced new or significantly improved product, means of production, means of marketing and means of organisational delivery). We used four different innovation indicators and three ICT indicators to measure innovation and ICT adoption by firms. Table 1 shows these indicators and the number of firms which have introduced such innovations in the last three years before the survey year (2013).

3.2 Methodological Approach

This paper purely adopts quantitative analysis. However, we acknowledge what Dana and Dana (2005) indicated that qualitative data might be reduced to quantitative codes for statistical analysis. The conversion of quantitative findings into detailed qualitative descriptions would be more difficult. Also, since we studied small informal firms, we allude to the fact that the use of inductive and non-quantitative research is a useful strategy, applicable to research in small business and entrepreneurship as well (Dana & Dana, 2005). As stated earlier, our data is a quantitative one, and there is no qualitative aspect featuring in the data. Thus, in a binary outcome, Let P_i represents the probability of a firm being innovative, say introducing a new or significantly improved product. In contrast, the probability of not being innovative is given as 1-P_i. We do not observe P_i because Y is a latent variable. Instead, we observe the outcome Y=1 if the firm has introduced new or significantly improved product or service (Innovation) and Y=0 if he does not, this give us the model specification in equation (1);

$$P_r(Y_i = 1) = P_i \qquad (1)$$

$$P_r(Y_i = 0) = 1 - P_i \qquad (2)$$

The probability of a firm innovating is represented in equation (3) as:

$$Pi = E(Y = 1|X) = \frac{1}{1 + e^{(\beta_0 + \beta' Xi)}} \qquad (3)$$

Where X is a vector of independent variables, and β is a vector of their respective coefficients.

For ease of expression and understanding, equation (3) is simplified. It is non-linearly related not only to the regressors but also to the parameters which can cause some estimation problems if ordinary least squares (OLS) estimation technique is to be applied. Thus, simplifying and reformulating equation (3), in terms of the odds ratio of the probability of a firm being an innovator or not will result in equation (4):

$$\left[\frac{Pi}{1 - Pi}\right] = \frac{1 + e^{(\beta_0 + \beta' Xi)}}{1 + e^{-(\beta_0 + \beta' Xi)}} \qquad (4)$$

$\left[\frac{Pi}{1-Pi}\right]$ is the odds ratio of a firm innovating and can thus be simplified as follows:

$$\left[\frac{Pi}{1 - Pi}\right] = e^{(\beta_0 + \beta' Xi)} \qquad (5)$$

Taking natural logarithms of equation 5 give the logit model with the log of the odds ratio, L, not only linear in X, but also in the parameters; *L* is called the logitand is summarised in (6).

$$Ln\left[\frac{Pi}{1 - Pi}\right] = Li = \beta_0 + \beta' Xi \qquad (6)$$

The following variables were used; gender of the top manager of a firm, whether firm competes with others, whether firm gives employees time to develop their ideas, firm spend on R&D, the number of employee firm has and whether the firm uses ICTs (cellphone, has its website and has email) in its operations. Four models are estimated based on the four different kinds of innovations, namely: product, process, organisational and marketing. We measure them as follows:

Model 1: a firm is a product innovator (i.e. has introduced a new or significantly improved product)

Model 2: a firm is a process innovator (i.e. has introduced a new or significantly improved method of production).

Model 3: a firm is an organisational innovator (i.e. has introduced a new or significantly improved organisational structure).

Model 4: a firm is a marketing innovator (i.e. has introduced a new or significantly improved marketing method).

If a firm has introduced such innovation, it is coded as zero, and if it does not, it is given one. For example, if a firm has introduced new or significantly improved product or service, it is given zero code and one if it does not introduce it.

Total annual sales or monthly sales are in continuous variable term. A set of variables that are dummies and are coded zero or one. They include: Gender (Female=0 Male=1); Email usage (Yes=0, No=1); Cellphone usage (Yes=0, No=1); website (Yes=0, No=1); Age of firm (greater than 20=0, less than 20=1), as well as other dummies (the legal status of firm) and location of the firm.

This study acknowledged that the adoption and use of ICTs could be considered endogenous to the firm as to whether or not a firm uses ICT is a decision. The above is in line with what Ramadani *et al.*, (2016) maintained that innovation activities are endogenously related to firm performance and that the performance of firms is influenced by knowledge spillovers and innovation activities, among other firm characteristics. However, the study maintains that in the African context, this issue may be as a result of some external issues like pressures from competitors who have adopted ICTs and are relevant in the industry. Also, Mustafa and Hughes (2018)indicated that firms in Africa, particularly Kenya, there are difficulties in acquiring vital resources such as financial, human capital, knowledge and technology to develop and sustain Corporate Entrepreneurship activities. Thus, firms could adopt ICTs simply because others have done so and are surviving in the industry.

4. Empirical Results and Discussion

4.1 Descriptive statistics

Table 1 presents the descriptive statistics and distribution of variables. Based on the number of years' firms have operated before the survey year, shows that in Ghana (77.72%) and Nigeria (71.57%) majority of the firms has operated in the last 20 years or less. The gender of the owner of the firm shows male-dominated firms of 70.99% male ownership in Ghana and 82.35% male ownership in Nigeria. Also, the gender of the top manager of the firm shows a male-dominated

as 86.22% of the firms in Ghana have their top manager being a male, and in the case of Nigeria, it is 88.86%.

Table 1 further shows that majority of the firms in Ghana and Nigeria are Sole Proprietors, that is 61.06% and 75.75% respectively. In percentage wise, Ghana has a less than 1% of firms that are shareholding firms with shares being traded. In comparison, Nigeria (3.08%) has percentages of more than 2% of their firms with shareholding status and shares being traded. Majority of the firms in both countries are SMEs as shown by the number of employees. In Ghana, 92.15% of the firms are SMEs, and in Nigeria, the figure is 94.50%. Firms' place of location and operation shows that majority are in Accra (48.08%) for Ghana and Nigeria (as reported in Table A1 inthe Appendix). Majority of the firms (49.32%) are located in eight different cities (Abuja, Anambra, Cross River, Kaduna, Kano, Lagos, Jigawa & Nasarawa). Comparatively, Lagos has the highest number (9.33%) of firms than the other cities.

Also, Table 1 revealed that 11% of the firms in Ghana are the subsidiary one that is they are part of a larger firm, while 89% are whole owned firm. Similarly, in Nigeria, 23.5% are subsidiary firms, and 76.5% are whole owned ones. In Ghana, a lesser number of firms (38%) give their employees the chance to bring on their ideas for innovation as against 62% of the firms that do not give employee chance to utilise their ideas to achieve innovation. Firm competing with other ones seems to be high as 67% of the firms in Ghana faces competition, and 52% of the firms in Nigeria faces competition. Majority of the firms (78% in Ghana and 83% in Nigeria) does not perform R&D or collaborate in performing R&D. On ICT adoption (cellphone, email and website) firms in Ghana (64.9%) use Email in contacting clients and suppliers than firms in Nigeria (26.76%) does. There is low adoption of website usage by firms in all the two countries, with firms in Ghana having the highest adoption rate of 33.49% as against 18.75% in Nigeria. For cellphone usage, it is generally on a higher adoption by firms from Ghana (93.59%). Data for Nigeria did not capture firms' adoption of cellphone usage in their business.

Table 1: Descriptive statistics and distribution of variables

Variable	Measurement	Response	Number and percentages of firms			
			Ghana		Nigeria	
			Percent	Obs.	Percent	Obs.
Number years	Number of years	>20	22.28	139	28.43	646
	firm has operated	20 or less	77.72	485	71.57	1,626
Region of operation	Place where the	Accra	48.08	300	A	A
	firm resides and	North	21.79	136		
	operates	Takoradi	9.46	59		
		Tema	20.67	129		
R&D expenses	Spend on R&D	Yes	21.96	137	17.47	397
		No	78.04	487	82.53	1,875
Gender of owner	Gender of the owner	Female	29.01	181	17.65	401
	of firm	Male	70.99	443	82.35	1,871
Gender of top	Gender of top	Female	13.78	86	11.14	253
manager	manager of the firm	Male	86.22	538	88.86	2,019
Legal status of firm	Legal status of firm	SST	0.96	6	3.08	70
		SSnT	4.49	28	4.67	106
		SP	61.06	381	75.75	1,721
		P	7.05	44	7.48	170
		LP	25.96	162	6.12	139
		Other	0.48	3	2.91	66
Competition	Firm compete with	Yes	68.75	429	51.72	1,175
	others	No	31.25	195	48.28	1,097
Chance for	Firm allowing	Yes	38.14	238	44.06	1,001
employee idea	employees to bring	No	61.86	386	55.94	1,271
	their ideas					
Subsidiary firm	Firm being part of a	Yes	10.90	68	23.50	534
	larger firm	No	89.10	556	76.50	1,738
ICT usage	Communicate with	Yes	64.90	405	26.76	608
	Clients and	No	35.10	219	73.24	1,664
	suppliers by Email					
	Has its own website	Yes	33.49	209	18.75	426
		No	66.51	415	81.25	1,846
	Communicate with	Yes	93.59	584	N/A	N/A
	Clients and	No	6.41	40	N/A	N/A
	suppliers by phone					
Firm type	Number of	SME (<99)	92.15	575	94.50	2,147
	employees firm has	Large(>99)	7.85	49	5.50	125

Note: SST=Shareholding company with shares traded; SSnT= Shareholding company with shares not traded; SP=Sole Proprietorship; P=Partnership; LP=Limited partnership; SME=Small & Medium enterprises. N/A=not available, A=figures are reported in the appendix.

4.2 Econometric results analysis

The results of our econometric models are shown in Tables 2 and 3. In Table 2, competing with other firms positively affects the innovation of firms. If a firm has competitors, it has 3.5% increase in the likelihood of being product innovator (i.e. introduced a new or significantly

improved product) in Ghana. Thus, competition forces firms to be innovative to help them survive in the industry. This finding is in line with that of Soames, Brunker and Talgaswatta (2011) and Gërguri-Rashiti *et al.*, (2017) who indicated that firms' innovation activities are higher if the firm has competitive pressure from foreign firms. A firm which top manager is a male has 7.3% increases in the likelihood of introducing a new or significantly improved method of production or service in Ghana, which is significant at 1% level than a female-headed firm. This is similar to what Rantšo (2016) indicated that the gender of an entrepreneur in Lesotho influences the success and performance of the enterprise.

Table 2 further shows that if a firm spends on R&D, it has a 12% increase in the probability of being product innovator, 11% increase in the likelihood of introducing a new or improved method of production or service, 18% increase in the chances of introducing new organisational structure and 14% in the case of introducing new marketing method compared to their counterparts firm that does not spend on R&D in Ghana. A firm that gives its employee's time to develop their ideas has 13% increases in the chances of being product innovator, 11.3% in the case of methods of production or service and 29% in the case of organisational structure and 15.6% in the case of being marketing innovative.

Further, in Table 2, if a firm is part of a bigger firm, it reduces the chances of being innovative. This is partly because a subsidiary firm may not take decisions, especially on innovations of the firm. This finding is in line with the Schumpeter (1942) that a smaller firm (subsidiary firm in this case) does not have the capacity to innovate. In a current study, Gërguri-Rashiti *et al.* (2017) maintained that the size of a firm is a determinant explaining innovation. Also, when the number of employees increases, it reduces the probability of the firm innovating. However, this finding is not significant on all the innovations measured.

On ICT adoption by firms in Ghana, Table 2 further shows that the use of email has a positive and significant effect on the four types of innovations. The use of email increases the probability of a firm introducing a new or significantly improved product by 7.7%. In comparison, in the case of organisational structure, it increases the likelihood by 9.6% and 6.2% in the case of marketing method. When a firm has its website, it increases the chances of it introducing new or improved organisational structure by 17.8% and 5.2% in the case of marketing method than a firm which has no website. Thus, ICT adoption offers an enabling means for firms to be innovative.

Table 2: Regression of Marginal Effects at Representative values for firms in Ghana

Explanatory variables	Product	Process	Organisational	Marketing
Compete with others (Yes)	0.035	0.031	0.01	0.03
	(0.02)	(0.02)	(0.04)	(0.02)
Gender of Top Manager (Male)	0.03	0.073***	-0.03	0.023
	(0.02)	(0.03)	(0.06)	(0.02)
Spend on R&D (Yes)	0.12***	0.11***	0.18***	0.14***
	(0.04)	(0.04)	(0.05)	(0.05)
Chance for employee's idea	0.13***	0.113***	0.29***	0.156**
(Yes)	(0.05)	(0.04)	(0.07)	(0.06)
Use email in its operations	0.077***	0.049*	0.096*	0.062**
(Yes)	(0.03)	(0.03)	(0.05)	(0.03)
Use cellphone (Yes)	0.02	0.05	-0.038	-0.049
	(0.04)	(0.05)	(0.08)	(0.04)
Has its own website (Yes)	-0.01	0.044	0.178***	0.052*
	(0.02)	(0.03)	(0.05)	(0.03)
Number of employees	-0.0002	-0.0002	-0.0005	-0.0002
	(0.0002)	(0.001)	(0.001)	(0.001)
Firm being part of larger firm	-0.05	-0.081	-0.152	-0.077
	(0.04)	(006)	(0.09)	(0.06)
Pseudo R^2	0.1559	0.1268	0.2106	0.2570
Prob>Chi^2	0.0000	0.0000	0.0000	0.0000
LR Chi2 (9)	134.49	109.59	174.50	220.45
Observations	624	624	624	624

Note: standard errors are within brackets; ***, **, * denote significant at 1%, 5% and 10% respectively
Source: Authors' Computation

For Nigeria, Table 3 indicates that competition has a positive effect on innovation. Firms that have competitors are 3% more likely to introduce the new or significantly improved product and 2.8%, 2.5% and 2.5% in the case of production method, organisational structure and marketing method respectively. For R&D firms, they are likely to be innovators than non-R&D firms. Their likelihood increases by 6.8% in the case of new product innovation and 6.7%, 11.7% and 8.3% in the case of new production method, new organisational structure and new marketing method, respectively.

Table 3: Regression of Marginal Effects at Representative values for firms in Nigeria

Explanatory variables	Product	Process	Organisational	Marketing
Compete with others (Yes)	0.03***	0.028***	0.025**	0.025***
	(0.01)	(0.08)	(0.01)	(0.01)
Gender of Top Manager	0.004	-0.01	-0.02	-0.01
(Female)	(0.01)	(0.01)	(0.02)	(0.01)
Spend on R&D (Yes)	0.068***	0.067***	0.117***	0.083***
	(0.01)	(0.01)	(0.02)	(0.01)
Chance for employee's idea	0.118***	0.129***	0.185***	0.115***
(Yes)	(0.02)	(0.02)	(0.03)	(0.02)
Use email in its operations	0.046***	0.017	0.02	0.004
(Yes)	(0.01)	(0.02)	(0.01)	(0.01)
Has its own website (Yes)	0.004	0.017	0.031*	0.019*
	(0.01)	(0.01)	(0.02)	(0.01)
Number of employees	0.0001	0.0001	0.0001	0.0002
	(0.0001)	(0.001)	(0.001)	(0.001)
Firm being part of larger firm	0.015	0.02**	0.031**	0.002
	(0.01)	(0.01)	(0.013)	(0.01)
Pseudo R^2	0.1331	0.1638	0.1991	0.1811
Prob>Chi^2	0.0000	0.0000	0.0000	0.0000
LR Chi2 (8)	419.04	515.60	611.87	568.11
Observations	2,272	2,272	2,272	2,272

Note: standard errors are within brackets; ***, **, * denote significant at 1%, 5% and 10% respectively
Source: Authors' Computation

Table 3 further shows that a firm that allows employees to bring their ideas for the betterment of the firm is 11.8% more likely to introduce new product and 12.9%, 18.5% and 11.5% in the case of new production method, new organisational structure and marketing method respectively than its counterpart. On ICT usage, firms which use email in their operation has 4.6% increase in the chances of introducing new product and firms that have their website has 3.1% and 1.9% increase in the likelihood of introducing new organisational structure and new marketing method respectively. If a firm is part of a larger firm, it has an increase in the likelihood of introducing new production method by 2% and 3.1% for new organisational structure.

4.2.1 Comparative analysis

Firms competing with other firms leads to the firm being innovative in all the four innovation indicators being studied in both countries. This is in line with other studies (Artés, 2009; Beneito *et al.*, 2011; Griffith, Harrison and Simpson, 2006; Howitt, 2004). However, the competition effect is not significant in Ghana. At the same time, it is very significant on introducing a new product, new organisational structure and new marketing method (models 1, 3 & 4) for firms in

Nigeria. It suggests that firms in Nigeria face higher competition than their counterparts in Ghana. Spending on R&D has a positive effect on innovation in all firms in both the studied countries. It is significant at 1% level in both countries.

Giving employee chance to develop their ideas has a positive and significant impact on all the four innovation indicators in both countries under study. The use of email in firms' operations is positive and significant to all the innovations both in Ghana and in Nigeria; using email is only significant in introducing a new or significantly improved product for the Nigerian firms, though it is positive to all the innovations. Use of cellphone has a positive effect on new or significantly improved product innovation and new or significantly improved method of production (models 1 & 2), but negative to new or significantly improved organisational structure and new or significantly improved marketing method (organisational and marketing innovations) in Ghana. However, the data for Nigeria did not capture cellphone usage by firms.

A firm having its website has a positive and significant effect on the firm introducing a new or significantly improved organisational structure and new or significantly improved marketing method in both Ghana and Nigeria. Being part of a larger firm is positive and significant to the firm introducing a new or significantly improved production method and new or significantly improved organisational structure (process & organisational innovations) in Nigeria but is negative to all the innovation type in Ghana.

5. Conclusion and implications

5.1 Conclusion

This paper sets out to look at competition and innovation of firms per how ICT adoption could foster the innovativeness of firms. Firms from two countries (Ghana & Nigeria) were studied to ascertain whether there are spatial differences in how ICT adoption affects innovation in SSA countries. It was established that competition leads to innovation in all the different kinds of innovations modelled in this paper. Firms in Nigeria are faced with higher competition than their counterparts in Ghana as the effect of competition on innovation is significantly higher and positively significant for firms in Nigeria compared with firms in Ghana. R&D expenditure was found to influence firm innovation in both countries strongly. Also, when a firm allows its employees to bring their ideas to bear in the firm’s activities, it helps the firm to achieve innovation.

On ICT adoption and its influence on firm innovativeness, the adoption of all the ICTs studied leads to innovations in the firm. Thus, ICT adoption positively influences or enhances innovation of firms in both countries, but the effects are different. Thus, ICT adoption supports the innovative efforts of firms in both countries.

As the fallout from this study, the paper recommends, among other things that firms should endeavour to adopt ICTs in their operations and allow their employees to contribute ideas on the firm decision and operations. R&D expenditure should be enhanced to help increase innovations in the firm. It will lead to increase output and growth for firms. Future researchers should look at multiple ICT gadgets adoption/usage and how it affects firm innovation. A panel data analysis could help tease out the knacks in this study. This study could not cover this aspect due to the limitation of data for the study. One weakness of the research methodology we engaged in examining these firms is that a quantitative strategy (that we used) often limits the ability to study context and environment (Dana & Dana, 2005). Thus, this does not give environmental explanatory variables such as the culture of the businesses. Hence, future studies can adopt the ethnographic approach in non-quantitative research would enhance our knowledge and understanding of such pertinent and critical factors.

5.2. Implications for research, practice and society

The study findings imply that research on innovative activities of informal firms is very much essential to sustain the competitiveness of such firms and to help them survive in the industry they operate in. Firms' innovation could much be the concern of how they compete with others, spending on R&D, employee self-innovation and ICTs adoption and usage. More research is needed in the dynamics and nature of ICT adoption and usage by informal firms (especially SMEs) in SSA. Both qualitative and quantitative methods could be adopted in future studies. However, researchers need to be sceptical about the adoption of ICT by a firm, as it could be considered as endogenous to the firm and not forces (i.e. exogenous) from outside the firm. In practice, firms should harness ICTs that helps to reduce their cost and time in production. Also, ICTs that help to connect with customers and suppliers could enable firms in discharging their mandate of producing for the society to have better access and consumption of better quality products.

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Appendix

Table A1: Firms' locational distribution in Nigeria

Region/State	Observation	Percentage
Abia	94	4.14
Abuja	131	5.77
Anambra	120	5.28
Cross river	124	5.46
Enugu	105	4.62
Kaduna	123	5.41
Kano	165	7.26
Lagos	212	9.33
Oyo	95	4.18
Gombe	118	5.19
Jigawa	121	5.33
Katsina	114	5.02
Kebbi	117	5.15
Kwara	113	4.97
Nasarawa	125	5.50
Niger	115	5.06
Ogun	87	3.83
Sokoto	94	4.14
Zamfara	99	4.36