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Broadband Telecommunication Deployment: A Supply Side Analysis of Penetration Drivers in A Developing Country Case

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Abstract

It is common to reference technology in the built environment to infrastructure like housing, water works, roads, bridges, and etcetera whenever construction is being discussed by even some supposedly informed persons. However, 'Broadband' is not just a technology but is fast becoming an important infrastructure needed to help the economic growth of any economy. Broadband availability/penetration, like other types of infrastructure, remains a serious development drawback in developing/least developed world regions like Nigeria which suffer a combination of 'digital' disadvantage and tight national budgets/low receipts hence providing high investment potential that has continued to attract international construction projects/ funding thus justifying the need to investigate the supply-side drivers responsible for broadband provision as an aid to private investors, and national governments policy-wise. The result of analysis reveals that ease of doing business, competiveness and corruption index collectively significantly affect broadband penetration

Keywords: broadband telecommunication technology, infrastructure, broadband penetration, penetration drivers, development.

INTRODUCTION

The World Trade Organization(WTO,2017), opines that ' technology' remains one of the three "pillars" by which to identify "smart destinations", including in our view, broadband technology, as part of telecommunication infrastructure with infrastructure denoting the ' basic structures/facilities essential for

modern economic growth and development(Kadiri et al,2015). On their part, The World Bank Telecommunication Sector Reform (WBTSR, 1991) had since rightly noted the contribution of telecommunication infrastructure to economic expansion/development and/or growth) hence denoting infrastructure as a development index as corroborated by the International Monetary Fund (IMF, 2010).

Broadband technology simply recognizes those technologies that make use of fixed or mobile connections for high-speed/high capacity data communication (FSR, 2011) with data speeds not below 256kbits/s (Chinemerem, Awodele, Kuyoro & Izang, 2015; FSR, 2011). Also significant is the huge digital imbalance between developed and developing/least developing countries as noted by sources such as ITU (2015); Kojo, (2014) respectively indicative of the following: internet access of households (80% vs.34%; 7% vs.46% [world average])(ITU,2015).The above picture clearly tilts the investment potential in favor developing/least developed world regions as noted by GSMA(2014), especially for Internet users. With complexity, short time-to-market, competition, continuous improvement, triple bottom line(planet, people, profit) as major considerations, procurement/management collaboration across national/regional boundaries via international projects becomes necessary and foreign private funding may be needed since infrastructure, especially the "telecommunication sub-sector is capital intensive"(Ebinimi,2015). Appropriate business models that factor in government facilitation through public policy also become necessary in order to achieve success as understood in this paper. The combined reference above to international projects and foreign funding accords with the idea of foreign direct investment (FDI), itself a "trending idea" (Ogbonna and Ohiri, 2017) in the twenty first century construction experience. Notwithstanding its criticisms (McGee and Edwards, 2010; Loewendahl, 2016), FDI simply refers to international capital movement (Nayak and Choudhury, 2014) or the ownership of production facilities by foreigners (Adrianony, 2016). The combination of 'digital imbalance' and 'investment potential tilt' referenced earlier compels a developing country case with which Nigeria fits as follows: low penetration(Kojo,2014; Chinemerem et al,2015); gross domestic product(GDP) contribution (8.5%,2015;9.8%,2016)(Ebinimi,2015; NCC,2016); sector investment volume($68bn,2016;FDI($38bn,2016), subscriber estimate -153m(approx.)(Ojobo,2016); investment potential-increasing data consumption, digital entrepreneurship, and large youth population(GSMA,2014); 97% estimated potential penetration rate (ITU,2015); 105.7% teledensity(2015)(NCC,2016). Related to the above scenario are the following challenges: high tariff/connectivity cost(Ebinimi,2015; Nwakanma, Asiegbu and Amadi,2012;Ezeh & Diala, 2014; GSMA,2014; low yield towards economic growth, domination by external players(Abdulahi,2013); absence of impact analysis(Okereke, Onwe & Agboola,2009); absence of proper business model(Posu,2006); and low private sector investment(GSMA,2014).

Since 'socio-economic impact' should be seen to directly convert to sustainable economic development, mobile broadband infrastructure can also be viewed under the strategic development goals (SDGs) agenda. Although more properly coming under development goal 9(industry, innovation and infrastructure), it can loop backwards to such goals as 4(quality of education); 10(reduced inequality); 11(sustainable cities/communities); 12(responsible consumption) (United Nations Development Programme, 2015) all of which can be seen to interest 21st century international construction stakeholders. The above indicated focus follows the recognition of "make or mar" impact of the nature and timing of government intervention on broadband penetration(Broadband Commission, 2015) which is exemplified by 10% compared to the planned 30%(National Broadband Plan(2013-2018) against 30% already achieved in countries like Ghana, Kenya, South Africa and Egypt (Ekpeke,2015). Notwithstanding the socio-economic impact potential of mobile broadband infrastructure, private sector investment in the area remains grossly insufficient for reasons including the interplay between poor understanding of consumer needs, focus on core market competition, network roll-out and regulation costs, and absence of appropriate business model (GSMA, 2014). The FDI slant of this paper therefore agrees with the need for a business model that can increasingly and sustainably stimulate private sector investment that is properly facilitated by the public sector as noted

by Katz (2010) hence the further need to ascertain drivers of broadband penetration using a supply-side perspective.

Broadband Technology and Economic Development: The Supply-Side Perspective

Preamble

Whereas business models tend to capture the value creation, delivery and capture mechanism employed to deliver a service including offering strategies, infrastructure, organization, trading practices and operational processes and policies (Katz, 2010), supply-side policies aim to reduce an operator's deployment costs or enhance private operator's access to market and finally, directly developing broadband infrastructure especially through public-private partnerships (FSR, 2011).

The relationship between telecommunication technology and economic development/growth has been recorded by several studies producing utilitarian business models such Jipp(1963), Bebee et al(1967) who using data from 29 countries at different stages of development and others but noted the absence of modern technology as a major obstacle to growth and poverty reduction.

Three key issues characterizing the supply-side approach relate to: presence several operators under a condition of high urban business and residential density; primarily residential density; and a low one operator typified by Nigeria before 2001 with sparse rural residential density.

Related Work and Research Gap

Research as early as Jipp (1963), and Bebee et al (1967), using 29 countries' data at different stages of development, and Hardy (1980) and Moss (1981) many studies have correlated telecommunication infrastructure and economic development. While Abutateb, et al (2001) found the absence of modern technology as a major obstacle to growth and poverty reduction, and Nandi and Dholakia (1994) did so for telephone infrastructure and economic development connecting a number of factors, Madden, et al (1998) tried to empirically relate gross fixed investment, telecommunication infrastructure investment, and economic growth for a sample of transitional countries of central and Eastern Europe. Kim et al (1997) showed telecommunication infrastructure to impact economic growth more than other traditional infrastructure as corroborated by Sridhar and Sridhar (2005) and noted for Nigeria by Juwah (2011) who noted that GDP rose from 0.06% to 3.66% from 1999 to 2009.

In terms of methodology, this paper notes the following: De Long and summer (1993) - regression analysis as well as instrumental variables; Cronin et al (1993b) -Peterson Index; Cronin et al (1991) - the Grange, Sims and modified Sims tests to confirm the existence of feedback process in which economic activity and growth stimulates demand for telecommunication services. On his part, Gupta (2000) submitted an estimate that 1% growth in telecommunication services generates 3% growth in the economy while Ncube, Gasela & Hatting (2013) used regression analysis and applications of linear response and surface analysis techniques and concluded that broadband penetration is a function of factors such as: innovation, freedom from corruption, fixed telephone subscribers per hundred, and institutional reforms just as Ajunwa's (2016) review concluded on the influences on broadband demand gap as: economic barrier, limited technology training, slow assimilation of broadband, uneven telecommunication network deployment and epileptic power supply. The difference in this paper's approach however, is that unlike Oshone & Anuoluwapo (2014) which though similar , did not decipher factors responsible for the growth or otherwise of the broadband this paper used distributed questionnaires (similar to Ncube, Gasela & Hatting (above), as well as secondary data while also analysing the relationship between the supply-side factors thereby filling the two gaps. On one hand, Verboven (2001) established broadband penetration as proxied by mobile telephony: delay in issuing licenses, persisting cross country differences, introduction of competition, higher GDP and larger fixed networks while Ah & Lee's (1999) 64-country study concluded that subscribership rate depends on country specific factors which include: national wealth, level of technological change and industrialisation, fixed network facilities, GDP and existing tariff systems. Rossotto, Kerf & Rohlfs (2000) simply concluded that competition increases mobile penetration by increasing market size and drove incumbent fixed network operators to improve their provision of fixed

services. The missing link in the above literature pieces is the absence of correlationship between demand growths for mobile telephony to other factors such as: calling party pays (CPP), or Receiving Party Pays (RPP) and innovative pricing arrangements e.g. multi-party tariffs and prepaid services which were covered in the work of Banerjee & Ros (2004) who raised other fundamental points as monopoly, transition from analogue to digital, mobile competition and end of monopoly, developing countries opening up to foreign investments, regulations not being so rigid on pricing of mobile telecommunication, creation of specialized regulatory structures and institutions known as National Regulatory agencies (NRA) which is known in Nigeria as Nigerian Communication Commission (NCC).

Incidentally, Banerjee & Ros (2004), excluded the entire African Continent in their work citing non-availability of complete and reliable data as basis which this paper remedies using Nigeria as a case to identify what all researchers have called 'region-specific' findings and specific drivers that may be peculiar to the Africa instead of simply generalizing as in Banerjee & Ros (2004).

Results and Discussion

The analysis used data from trading economics, and Nigerian Communication commission (NCC) for the 2008 to 2016 time period, as well as Internet live statistics. Data was available only for corruption index, competitiveness, ease of doing business and taxation. These were regressed against the number of internet users for the period under review. Table 1 shows the secondary data.

Table1: Data of Supply-side factors affecting broadband penetration.

Year	Corruption Index (X1)	Competitiveness(X2)	Ease of Doing business(X3)	Corporate Tax rate X4	Broadband Penetration (% of Internet Users) Y
2008	27	3.69	120	**30**	**15.9**
2009	25	3.81	125	**30**	**20**
2010	24	3.64	133	**30**	**24**
2011	24	3.37	133	**30**	**28.4**
2012	27	3.44	138	**30**	**32.8**
2013	25	3.67	147	**30**	**38**
2014	27	3.57	170	**30**	**42.7**
2015	26	3.43	170	**30**	**45.1**
2016	28	3.46	169	**30**	**46.1**

Source: NCC, Trending economics and Internet Live statistics (2017)

Using Statistical Package for Social Sciences (SPSS) software yielded the Table 2-Table 6 below.

Table 2: Descriptive Statistics

	Mean	Std. Deviation	N
Broadband Penetration	32.5556	11.17443	9
Corruption Index	25.8889	1.45297	9
Competitiveness	3.5644	.14800	9
Corporate tax rate	30.0000	.00000	9

Table 2, the descriptive statistics of the variables studied produced the following: broadband penetration average as **32.55% (**past 9 years); corruption index averaged: **25.89**; competitiveness: 3.56, ease of doing business: 145; and corporate tax remained unchanged: **30%**. Table 3 below revealed that ease of doing business correlated as high as 0.96 implying that broadband penetration improves on ease of doing business followed by corruption index, and competiveness while corporate tax remained unchanged in the last 9 years; it is understandable that it does not correlate with broadband penetration. However, a look at the t-significance further showed that Corruption index only, seemed not to have a significant effect when considered alone.

Table 3: Correlations

		Broadband Penetration
Pearson Correlation	Broadband Penetration	1.000
	Corruption Index	.411
	Competitiveness	-.568
	Ease of Doing business	.964
	Corporate tax rate	.
Sig. (1-tailed)	Broadband Penetration	.
	Corruption Index	.136
	Competitiveness	.055
	Ease of Doing business	.000
	Corporate tax rate	.000

a. Dependent Variable: Broadband Penetration
b. All requested variables entered.

Table 4: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	df1
1	.972[a]	.946	.913	3.29465	.946	29.009	3

a. Predictors: (Constant), ease of Doing business, Corruption Index, Competitiveness

Having an R-square value of **0.946** or 94.6% showed that the independent variables account reasonably for the change in the broadband penetration in Nigeria. This was confirmed using ANOVA table 5 which shows that Sig-F change is **0.001** which is lower than **0.05** thus we conclude that the independent variables collectively have significant effect on the broadband penetration in Nigeria.

Table 5: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	944.669	3	314.890	29.009	.001[b]
	Residual	54.274	5	10.855		
	Total	998.942	8			

a. Dependent Variable: Broadband Penetration
b. Predictors: (Constant), ease of Doing business, Corruption Index, Competitiveness

Table 6: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.879	41.287		.070	.947
	Corruption Index	-.278	.904	-.036	-.308	.771
	Competitiveness	-10.469	8.962	-.139	-1.168	.295
	Ease of Doing business	.512	.074	.915	6.957	.001

a. Dependent Variable: Broadband Penetration

Based on table 6, the coefficient regression model can be formulated but corporate tax was removed since it does not correlate because it has remained constant for the past 9 years. However, the model is given as:

Broadband Penetration = 2.879-0.278(Corruption Index)-10.469 (Competitiveness) +0.512 (Ease of doing Business) equation 1

This model is **94.6%** reliable for inference making. It also means that reduction in corruption and removal of forces that prevent competition in the telecommunication sector will improve both broadband penetration and ease of doing business in Nigeria. These findings accord with basic economics but specifically in Nigeria, the ease of doing business in the telecommunication sector will involve but not be limited to the following: improvement in power supply via telecommunication infrastructure development/operation cost thereby reducing cost of broadband provision especially that of right of way (**ROW**) encountered in major states in Nigeria. This can be achieved by a national or state dry duct infrastructure pool to be subscribed to by service providers rather than the present method of provision by each provider and which are not protected from damage by others, especially, had infrastructure such as roads, resulting from the absence /non-enforcement of clear-cut policies. Similarly, the issues of multiple taxation for ROW at different levels of government, and co-location of facilities/equipment need to become policy features in order to ease doing business and increase roll-out times in Nigeria.

Summary, Conclusion and Recommendations

1. Licensing new operators to deliver broadband services using the latest technologies
2. Encourage and support policies and solutions that will urgently resolve the infrastructure crisis as it relates to power supply and inter-city broadband data transmission networks
3. Remove bottlenecks that prevent cabling companies from freely securing rights of way
4. Identifying factors affecting fixed telephone companies and ISPs towards (a) gaining a deeper understanding of the problems. (b) Designing policies to reverse the negative trends.
5. Creation of demand for broadband access through creation of local content and e-services like e-government, e-commerce, e-learning etc (Ajayi, 2016)

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