THE USE OF SEGMENT FINANCIAL INFORMATION FOR DECISION MAKING[1]

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ABSTRACT

The purpose of this paper is to examine the usefulness of operating segments financials in the decisions to create operating segments, and in choosing between line of business (LOB/product) and geographic bases of segmentation. Using statistical methods, we analyze 2014 and 2015 data from e-annual reports and financial statements of 75 companies (except for the financial services industry) trading on the Nigerian Stock Exchange. Result of binomial logistic regression suggests there is likelihood that earnings before interests and taxes and total liabilities significantly affect the choice of basis of segmentation. Specifically, we find the likelihood that increase in earnings before interests and taxes significantly decreases the choice of LOB/product basis of segmentation, thereby increasing the geographic basis. We find the likelihood that increase in total liabilities significantly increases the choice of LOB/product basis, consequently decreasing the geographic basis of segmentation. We do not find any likelihood that revenues, book value of total assets and depreciation and amortization expenses significantly affect the choice of bases of segmentation. Our OLS regression results suggest that earnings before interests and taxes and total liabilities significantly affect the number of operating segments created by the chief operating decision makers, CODMs. We find that earnings before interests and taxes (total liabilities) decrease (increase) the number of operating segments created by CODMs.

We therefore recommend that company managers should use earnings before interests and taxes and total liabilities when deciding to segment operating units and when deciding to create operating segments.

Key words: IFRS 8; Operating segments; OLS regression; logistic regression; Chief operating decision maker; management

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I. INTRODUCTION

The financials of operating segments can help chief operating decision makers (CODMs) of companies to allocate resources to operating segments. This paper investigates how operating segments prior year's financials (revenue, earnings before interests and taxes, total liabilities, and depreciation and amortization expenses) can be used by chief operating decision makers' (CODMs)[3] to choose a basis of segmentation, and to create additional operating segments. An operating segment is defined as a component of an entity that engages in business activities from which it may earn revenues and incur expenses. The results of operating segments are regularly reviewed by a company's CODM for making decisions about resources to be allocated to operating segments, for assessing operating segments performance, and for which there are discrete financial information. A reporting segment is defined as the organizational units for which product- or geographical-based information is reported to key management personnel for performance assessment and future resource allocation.

International Financial Reporting Standard (IFRS) 8, requires the chief operating decision maker to identify and measure the performance of reportable segments in a manner that is consistent with the company's internal reporting structure. IFRS 8 applies to the consolidated financial statements of a group with a parent (and to the separate or individual financial statements of an entity) whose debt or equity instruments are traded in a public market; or companies that file, or is in the process of filing their (consolidated) financial statements with regulatory agencies, for the purpose of issuing any class of instruments in a public market.

Nigeria is an emerging market in Africa. It has the biggest and fastest growing economy in Africa. The country has an expanding manufacturing, service, communications, oil and gas, financial, and technology sectors, and it has one of the largest pools of investment capital on the African continent.

A study of the effects of operating segments revenue, earnings before interests and taxes, total liabilities, and depreciation and amortization expenses of such an important and emerging economy is warranted. This study, focusing on decision usefulness of segments financials, has the potential to help CODMs of companies operating in emerging economies like Nigeria to allocate resources to operating segments. The study can also influence CODMs in deciding whether to segment their company's business operation on line of business/product or geographic basis. Furthermore, the overall benefit of the paper is in its attempt to show one useful way to which operating segments financials can be used.

[3] The chief operating decision maker could be an individual, such as the Chief Executive Officer or the Chief Operating Officer, or a group of executives, such as the board of directors or a management committee (Ernst & Young, 2009).

This paper draws upon the proprietary cost theory (Ettredge, Kwon & Smith (2002); and Berger & Hann, 2007) and agency theory (Jensen & Meckling, 1976), although the paper is not out to test these theories. Here is a brief motivation of how these theories are relevant to the paper. The disclosure of operating segments financials can lead to proprietary cost when operating segments sensitive financial information are disclosed or revealed to the public among whom are the company's competitors. This can cause competitive harm to the company, so that based on its financials the company can choose the basis of segmentation that reduces the proprietary cost. As for agency theory, the relationship between owners (principals) and executives or managers (agents) requires managers to keep their principals informed about their performance in the running the company. The chief operating decision makers (as managers and agents) of quoted companies are required to report to their shareholders (the principals) the activities and results of operating segments under their management. Some of the diverse shareholders of companies can economically get information about operating segments under their companies through the annual reports prepared by the agents.

This paper has two objectives. The first is to investigate the relationship between one-year lagged operating segments financials and the choice of basis of segmentation. As indicated earlier, the proxies for operating segments financials include revenue, earnings before interests and taxes, total liabilities, and depreciation and amortization expenses. These proxies are contained in IFRS 8. It is possible for chief operating decision makers (CODMs) to use prior year's financials of operating segments to decide whether to segment on line of business/product (LOB/product) basis or on geographic basis.[4] Because of this it is expected that the magnitude of prior year's operating segments financials can influence the choice of basis of segmentation of operating units. The second objective of the paper is to investigate the effect of operating segments one-year lagged financials on the number of operating segments that can be created by CODMs. It is possible that when existing operating segments are doing well financially it can lead to the creation of additional segments that should be harnessed. Therefore, it is expected that the magnitude of operating segments prior year's financials can lead to the creation of additional segments by CODMs.

Binomial logistic regression is applied to test the first aspect of the investigation. We find the likelihood that increase in earnings before interests and taxes significantly decreases the choice of LOB/product basis of segmentation, thereby increasing geographic basis of segmentation. This finding suggests there is likelihood that increase in total liabilities significantly increases the choice of LOB/product basis, consequently decreasing the geographic basis of segmentation. OLS regression is applied to test the second strand of the paper. The documented result indicates that earnings before interests and taxes (total

[4] The empirical data show there are three bases of segmenting operating units including LOB / product, geographic, and a combination of LOB/product and geographic. The data analysis excludes companies segmenting their operating units on LOB/product and geographic at the same time.

liabilities) decrease (increase) the number of operating segments created by CODMs. Overall, the results suggest that revenue, book value of total assets, and depreciation and amortization expenses do not significantly affect the choice of basis of segmentation nor the number of operating segments created by CODMs.

Segment reporting is one of the most important aspects of financial reporting for investors and stakeholders of financial statements. Prior researches (e.g., Kajuter & Nienhaus, 2017) have examined segment reporting usefulness from investors' point of view. Segment information provided by management can help investors to carry out due diligence before investing or to do a detailed assessment of companies after investing in them. Segment information enables investors to have thorough insight of a company before or after investing in them. Overall, segment reporting reduces information asymmetry between management and investors such that investors are able to reduce risk perception about companies.

Prior studies (e.g., Kopecká, 2016; Aleksanyan & Danbolt, 2015; and Moldovan, Andréa & Filip; 2016) analyze the quality of IFRS 8 segment reporting disclosure, the average number of segment items disclosed, and the extent of compliance with IFRS. These studies compare IFRS 8 disclosure regime against IAS 14 disclosure regime. In particular, Aleksanyan & Danbolt (2015) examine the impact of changes in segment reporting rules on the amount and types of segmental information disclosed by companies and compare important qualitative and quantitative features of the segmental information actually disclosed by UK companies under each standard.
Most of the prior studies on segment reporting are descriptive. The current paper uses empirical data of Nigerian quoted companies. The paper is motivated by the need to examine empirically how management can put segments financial information to use in choosing a basis of segmentation and in creating additional number of operating segments.

Using Nigeria data, this paper contributes to the literature on segment reporting by providing insights about the usefulness of operating segments financial information to CODMs. In particular, it recommends that aspects of operating segments financials, especially, earnings before interests and taxes, total liabilities, and depreciation and amortization expenses should be taken into consideration when choosing a basis of segmenting operating/units, and when creating addition number of operating segments in a company by CODMs.

The rest of the paper proceeds as follows. The next section presents a review of prior literature and research hypotheses. Section 3 presents the research design, variables definition and measurement. Section 4 presents the results and discussion while section 5 concludes.

II. LITERATURE REVIEW AND HYPOTHESES

Literature review

Some authors argue that operating segments information is incrementally useful when compared to consolidated financial information. Kajuter & Nienhaus (2017) carry out a review of these prior studies. Kajuter & Nienhaus (2017) examine the usefulness of segment reporting under the management approach and find that the introduction of IFRS 8 improved the value relevance of segment reporting when compared to IFRS 14, which was a preceding IASB standard.[5] Kajuter & Nienhaus (2017) then conclude that the benefits of IFRS 8 operating segment reporting requirements for investors seem to outweigh the potential drawbacks of less comparability between companies. Meanwhile, some critics argue that companies could decide to introduce another reporting level at a more aggregated level and then deem this level as the CODM level to avoid the disclosure of information about specific segments, because companies are mindful of releasing proprietary information that may fall into the hands of their competitors. For example, Crawford, Extance, Helliar & Power (2012) provide insight about how some of their respondents feared that some companies might change what is reported to the CODM to avoid disclosing commercially sensitive segmental information. Kopecká (2016) believes reporting information under IFRS 8 is challenging for users as well as for preparers. Moldovan *et al*. (2016) argue that even financial analysts who are thought to be sophisticated users of financial statements do not always understand the quality of segment disclosures. They then conclude that business-model type of standards creates difficulties even for the sophisticated user.

At the cross-country level, prior papers have suggested some factors that can affect a company's decision to disclose segment information. Among these are Herrmann & Thomas (1996), who find firm size to be a significant factor affecting a company's quality of segment disclosures. Herrmann & Thomas (1996) find that larger firms provide higher quantity of segmental information than smaller firms. Stanford (1998) considers three main economic factors that can affect segment disclosing decisions. They include the operating segment's competitive environment, the motivations to disclose associated with earnings perspectives as well as the size of the company. Hayes & Lundholm (1996) examine how companies choose the degree of disaggregation in segmental disclosures by because those disclosures are provided information to both capital markets participants and competitors. The authors argue that it is more likely for a firm to provide disaggregated information when a segment shows persistently high performance. Hayes & Lundholm (1996) results suggest that a company's decision regarding the amount of segment information disclosed depends on the company's resolution to protect its segments with the highest profits. It seems that companies prefer to aggregate highly

[5] It is worth emphasizing that this paper has no policy implication for standards setting.

profitable segments with others that show lower profits, to suppress the arrival of new competitors.

Berger & Hann (2007) investigate whether managers face proprietary cost and agency cost motives to hide segment information. They hypothesize that when the proprietary costs are relatively high, managers will tend to avoid revealing information about segments with relatively high abnormal profits. On the other hand, when the agency costs are high, managers will withhold information of the segments with relatively low abnormal profits. The authors' analysis is consistent with the agency costs hypothesis but shows mixed results regarding the proprietary costs hypothesis.

Basis of segmenting operating units

Moldovan *et al*. (2016) opine that managers' discretion to crop segments for reporting purposes has long been recognized in the literature. According to Moldovan *et al*. (2016), the basis of segmentation could be by products and services, geographic area, legal entity, customer type, or other bases if they are consistent with the internal structure of companies. The authors observe that segment disclosures provide decision useful information to users of financial statements.

IFRS 8 requires greater disclosure of primary segments information than secondary segments information. Aleksanyan & Danbolt (2015) argue that the reason for less disclosure of secondary segment information is the proprietary information which geographic disclosure may reveal, and thereby results in competitive harm (Verrecchia (1983), Leuz & Verrechia (2000), Ettredge *et al*. (2002), Berger & Hann (2007), Botosan & Stanford (2006). Tsakumis, Doupnik & Seese (2006), Aleksanyan & Danbolt (2015), and Moldovan *et al*. (2016)). According to these authors, the disclosure of operating segments financial information may be beneficial to competitors in ways that may harm a company's prospects and cash flows. Aleksanyan & Danbolt (2015) write that increased disclosure requirement of accounting items for operating segments under IFRS 8 is likely to increase the risk of disclosure of segment-level proprietary information. To the disadvantage of disclosing companies, the more specific the reported segment disclosure the higher the risk and cost of proprietary information disclosed, so that companies prefer aggregated segments disclosures to reduce the increased risk and cost of proprietary information disclosure.[6] Given the latitude accorded to CODMs under IFRS 8, which does not specify detailed line-items to be disclosed by companies, CODMs have discretion in determining the degree of specificity of segment disclosures. Indeed, Moldovan *et al*. (2016) find that managers solve proprietary concerns either by deviating from suggested line-item disclosure in the standard, or, if following standard guidance, by decreasing segment reporting quality.

[6] The reader is informed that this paper does not test the proprietary cost theory *per se*.

Number of reported operating segments

Aleksanyan & Danbolt (2015) and Hope, Kang, Thomas & Vasvari (2009) demonstrate that the number of reported operating segments can vary among companies. In particular, Aleksanyan & Danbolt (2015) argue that it is plausible that IFRS 8 has a differential impact on the number of operating segments in different jurisdictions. Heem & Valenza (2012) examine the relationship between number of operating segments reported and change in reporting standards. Odia & Imagbe (2015) review some prior literatures on operating segments and related standards. However, it is instructive to note that the authors did not cite any extant studies that use the financials of operating segments in their investigation. There are no prior papers that have investigated the effect of magnitude of operating segments financials on basis of segmentation and on number of operating segments that can be created by CODMs. This is the novelty of our current paper.

The paper, therefore, contributes to the literature on usefulness of operating segments financial information. According to the expectations of the paper, the followings are the hypotheses being tested.

Hypotheses

Berger & Hann (2007) have found that a change to a new standard can led to an increase in the number of segments reported by companies. Harris (1998) argues that a change in standards can increase the number of segments reported.[7] Aleksanyan & Danbolt (2015) and Hope *et al*. (2009) demonstrate that the number of reported operating segments can vary among companies. It can be argued that the fundamentals of operating segments can be a reason why the number of operating segments varies among companies. The magnitude of operating segments prior year's financials can motivate the CODM to create additional operating segments, if existing operating segments are doing well financially. The CODM, upon reviewing the financials of operating segments, may decide to create (or not to create) more operating segments.

It is expected that the magnitude of operating segments prior year's financials affects the choice of basis of segmentation. The first alternative hypothesis is therefore coughed thus:

H1: There is likelihood that operating segments prior year's financials affect the choice of basis of segmentation

It is expected that the magnitude of operating segments prior year's financials can increase the number of operating segments created, so that we hypothesize in the alternative that:

H2: Operating segments prior year's financials increase the number of operating segments created.

[7] Again, the emphasis is made that this paper has no policy implication for standards setting.

III. DATA AND METHODOLOGY

Data, sources, sampling method and coding

Data and source

In keeping with IFRS 8, the financial information provided to the CODM, and for which data were hand-collected include revenue, earnings before interests and taxes, total assets, total liabilities, and depreciation and amortization expenses. Other operating segments information that we hand-collected include basis of segmentation, and number of operating segments. All of these are found in the notes to the accounts in published *e*-annual report and accounts. In effect IFRS 8 and prior papers informed the choice of variables for the research.

Sources of data

The research data come from 75 publicly traded companies in the non-finance services industry which are quoted on the Nigerian Stock Exchange. For completeness, these companies are listed in Table 1.

Table 1. Companies used in the analysis of operating segments

1. Afromedia Plc	26. IHS Nig Plc	51. SCOA Nigeria Plc
2. R.T. Briscoe (Nigeria) Plc	27. May & Baker Nigeria Plc	52. C & I Leasing Plc
3. Evans Medical Plc	28. Julius Berger Nigeria Plc	53. Caverton Offshore Support Grp Plc
4. Dangote Flour Mills Plc	29. Pharma Deco Plc	54. Airline Services & Logistics Plc
5. Honeywell Flour Mills Plc	30. Chams Plc	55. DAAR Communications Plc
6. AshakaCem Plc	31. Conoil Plc	56. Transcorp of Nigeria Plc
7. GlaxoSmithKline Nigeria Plc	32. Dangote Cement Plc	57. UACN
8. Multi-Trex Integrated Foods Plc	33. Eterna Plc	58. Oando Plc
9. Nestle Nigeria Plc	34. Ikeja Hotels Plc	59. ABC Transport Plc
10. Unilever Nigeria Plc	35. John Holt Plc	60. FrieslandCampina WAMCO Nig Plc
11. UACN Property Dev Co. Plc	36. Nigerian Enamelware Plc	61. Flour Mills of Nigeria Plc
12.Neimeth Int'l Pharmaceuticals Plc	37. Multiverse Plc	62. Aluminum Extrusion Industry Plc
13. Courteville Business Solutions Plc	38. MRS Oil Nigeria Plc	63. Costain (West Africa) Plc
14. First Aluminum Nigeria Plc	39. Total Nigeria Plc	64. RAK Unity Petroleum Plc
15. Chemical & Allied Products Plc	40. DN Meyer Plc	65. Portland Paints & Products Nig. Plc
16. Omatek Ventures Plc	41. Morison Industries Plc	66. Berger Paints Nigeria Plc
17. Vitafoam Nigeria Plc	42. Forte Oil Plc	67. Avon Crowncaps & Containers Nig. Plc
18. Dangote Sugar Refinery Plc	43. Red Star Express Plc	68. Japaul Oil & Maritime Services Plc
19. A. G. Leventis (Nigeria) Plc	44. Livestock Feeds Plc	69. eTransact International Plc
20. Cadbury Nigeria Plc	45. University Press Plc	70. CWG Plc
21. Mobile Oil Nigeria Plc	46. IPWA Plc	71. Northern Nigeria Flour Mills Plc
22. Lafarge Cement WAPCO Nig Plc	47. Okomu Oil Palm Co. Plc	72. Paints and Coatings Mafrs Nig. Plc
23. Fidson Healthcare Plc	48. Nigerian Ropes Plc	73. Portland Paints & Products Nig. Plc
24. Roads Nigeria Plc	49. UTC Nigeria Plc	74. Computer Warehouse Group Plc
25. Chellarams Plc	50. ARBICO PLC	75. NCR (Nigeria) Plc

Sampling method

Initially, 80 companies were identified from the Nigerian Stock Exchange website at http://www.nse.ng, under the "listed equities" page. There are circa 141 non-finance companies listed on the NSE as at 2015. Through the internet addresses provided at http://www.nse.ng the websites of the companies were located. Following Asien (2016), companies that did not have a website, or companies whose websites were inaccessible as at the time of data collection were excluded. Also, companies whose websites were accessible but whose *e*-annual report and accounts could not be downloaded were excluded. The annual report and accounts of the companies were downloaded from the websites, from there we located the "operating segments" or "segment reporting" section under the notes to the accounts sub-section. Finally, the segments financials, number of operating segments and basis of segmentation were extracted. Through these filters variables data on 75 companies were hand-collected based on availability of data on the variables. In order to transform the financials data into natural logarithms, five of the companies that had negative earnings before interests and taxes for the two periods (2014 and 2015) were deleted. This left a final sample of 75 companies that featured in the ensuing analysis.

IFRS 8 requires companies to disclose segment information by either LOB/product or geographical area, and to disclose the primary or secondary format of segment reporting. Whether primary or secondary format, the type of business segmentation is voluntarily determined by the CODM based on the company's internal reporting structure. Where an entity discloses both primary and secondary financial information, the primary information is collected. Where an entity discloses only primary or only secondary financial information, then that is the information collected.

Coding

To conduct the analysis in the remainder of the paper, disclosure on LOB/product basis is coded "1" and those on basis of geography is coded "0". Table 2 provides descriptive information on the number of segments by number of observations. The table shows that 14 (18.7%) of the companies had 2 operating segments each while 16 (21.3%) had 3 operating segments each and another 16 companies had 5 operating segments. Five (6.7%) of the companies had the highest number (7) of operating segments. Eleven companies had 6 operating segments.

Table 2. Number of segments by number of observations

# of Segments	Companies	Percent	Valid Percent	Cumulative Percent
2	14	18.7	18.7	18.7
3	16	21.3	21.3	40.0
4	13	17.3	17.3	57.3
5	16	21.3	21.3	78.7
6	11	14.7	14.7	93.3
7	5	6.7	6.7	100.0
Total	75	100.0	100.0	

A content analysis of the companies' disclosure narratives on operating segments uncovered four segment disclosure possibilities among the companies. Some companies disclosed that they did not have operating segments, these were excluded during the data collection. Fifty-four companies (72%) disclosed that they segment on LOB/product basis. Twenty-one companies (28%) disclosed that they segment on geographic basis. Finally, four companies disclosed that they segment on both LOB/product basis and geographical basis at the same time, these were also excluded during data collection; so that only the 75 companies in the second and third categories are used for the analyses. Table 3 provides information on the companies and their bases of segmentation.

Table 3. Companies and Bases of Segmentation

	Number	Percentage	Valid Percent
Geographical	21	28.0	28.0
LOB/Product	54	72.0	72.0
Total	75	100.0	100.0

From Table 3, it can be seen that segmentation along LOB/product basis remains the preferred primary option for reporting segment information by the companies. This is consistent with Aleksanyan & Danbolt (2015), who find that 77% of their 127 sampled companies disclosed LOB/product as their primary reporting basis as while 23% disclosed that they segmented on geographic basis. With a higher threshold, Kajuter & Nienhaus (2017) find that 80.7% of their sample reported on LOB/product basis. Aleksanyan & Danbolt (2015) argue that geographic information is proprietary cost laden, hence fewer companies that disclosed geographic basis. Between 2014 and 2015 none of the companies changed from one basis of segmentation to the other.[8] Heem & Valenza (2012), Nichols & Street (2007), and Nichols, Street & Tarca (2013) confirm this by their findings that companies do not change the number of operating segments from one period to another.

[8] It is possible for companies to increase or decrease their number of operating segments (e.g., Hope *et al.*, 2009; Aleksanyan & Danbolt, 2015). Many thanks to a conference participant for providing this insight.

The Models

Basis of segmentation

To test hypothesis 1, a one-year lagged binominal logistic regression was run for companies that segment based on either LOB/product, which is the reference group, or on geographic basis. The one-year lagged logistic equation is given as,

$$Probe(LOB)_t = \alpha + \eta_1 ln(REV_{t-1}) + \eta_2 ln(EBIT_{t-1}) + \eta_3 ln(TA_{t-1}) + \eta_4 ln(TL_{t-1}) + \eta_5 ln(DEAM_{t-1}) \ldots (1)$$

Where: *Prob(LOB)*, the criterion variable, is coded 1 if segmentation is according to LOB/product basis, and 0 otherwise. The predictor variables are *ln(REV), ln(EBIT), ln(TA), ln(TL)*, and *ln(DEAM).* *REV* is revenue from external customers, *EBIT* is earnings before interests and taxes. *TA* is total assets, which is used as a control variable. *TL* is total liabilities, and *DEAM* is depreciation and amortization expenses. *ln* symbolizes that the predictors are natural log transformed. Specific mention of these variables can be found in IFRS 8, companies' disclosures on operating segments in annual report and accounts, and in prior studies including, to mention but a few, Kajuter & Nienhaus (2017), Kopecká (2016), and Heem & Valenza (2012).

a = intercept of the equation. η_1, η_2 η_3, η_4, and η_5 = the coefficients of the predictor variables. The italicized subscript $_t$ and $_{t-1}$ represent year 2015 and 2014, respectively. Equation (1) is not meant to imply any statistical causality. The interest is to investigate the likelihood that operating segments financials (the predictors) can affect the probability of choosing line of business as basis of segmentation. The measurement of the variables is further explained in Table 4.

Number of operating segments

The hypothesis that high magnitude of segments financials can subsequently increase the number of operating segment created is also tested. To test for this, OLS linear regression equation is specified. It is of the type,

$$\mathbf{NSEG_t = \alpha + \eta_1 ln(REV_{t-1}) + \eta_2 ln(EBIT_{t-1}) + \eta_3 ln(TA_{t-1}) + \eta_4 ln(TL_{t-1}) + \eta_5 ln(DEAM_{t-1}) \quad \ldots (2)}$$

Where: The dependent variable is number of operating segments, $NSEG_t$. The one-year lagged independent variables are *ln(REV), ln(EBIT), ln(TA), ln(TL)*, and *ln(DEAM)*. All these variables have been previously defined as for equation (1). Equation (2) does not imply any statistical causality but that of association between the operating segments financials and the number of operating segments that can be created by CODMs.

Control variable

Among the right-hand-side variables in equations (1) and (2), total assets are used to proxy firm size and as a control for potential omitted variables. This is consistent with most firm-level studies that use total assets as a proxy for firm size. For examples, Herrmann & Thomas (1996) find firm size to be a significant factor that affects firms' quality of segment

disclosures while Stanford (1998) considers the size of a company as one of the main economic factors that can affect segment disclosing decisions. Aleksanyan & Danbolt (2015) and Hope *et al*. (2009) find that the number of operating segments can vary among companies. This paper reasons that it is possible for size to moderate the choice of LOB/product or geographic segmentation basis. It is possible that large firms and small firms face different prospects of being segmented into manageable operating units.

Table 4. Measurement of variables

Revenue (REV_{t-1})	Revenue from external customers only.
Earnings before interests and taxes ($EBIT_{t-1}$)	Earnings before interests and taxes does not include management bonus expense, share-based payment expense, finance revenue or finance costs, while the additional segment revenue included in segment earnings before tax is not included in the consolidated earnings before tax.
Total assets (TA_{t-1}) (control variable)	Total segments assets include receivables related to recognition of revenue and do not include deferred tax assets managed on a group basis. Non-current assets consist of properties, plants and equipment, investment properties, intangible assets and investment in an associate.
Total liabilities (TL_{t-1})	Liabilities include loans and borrowings which are attributable to or allocated to operating segments.
Depreciation and amortization expenses ($DEAM_{t-1}$)	This include depreciation and amortization expenses associated with operating segments non-current assets.
No. of segments	Measured at year t = 2015 data from segment information in annual the reports
Basis of segmentation	Measured at year t = 2015 data from segment information in annual reports
t-1	2014

IV. EMPIRICAL RESULTS

Descriptive statistics

The descriptive statistics of the variables are presented in Table 5. The minimum (maximum) number of operating segments is two (seven) while the average is about four. This average compares well with that of Kajuter & Nienhaus (2017), who find the mean number of operating segments in Germany to be 3.81. Basis of segmentation is coded 1 if segmented on the basis of LOB/product, and 0 otherwise. Seventy-two percent of the companies segmented their operations on LOB basis while the remainder (28%) segmented on geographical basis.

Table 5. Descriptive Statistics (N=75)

	Min	Max	Mean	Std. Dev
$ln(REV_{t-1})$ (₦*'000*)	12.61	20.33	16.9105	1.74225
$ln(EBIT_{t-1})$ (₦*'000*)	12.12	19.36	15.4431	1.81413
$ln(TA_{t-1})$ (₦*'000*)	13.45	20.71	17.1504	1.81426
$ln(TL_{t-1})$ (₦*'000*)	11.58	20.61	16.6429	2.03188
$ln(DEAM_{t-1})$ (₦*'000*)	9.09	17.14	13.3706	1.99235
Basis of Segmentation$_t$	0	1	.72	.452
Number of Segments$_t$	2	7	4.12	1.542

Bivariate correlation analyses

The bivariate correlations between the variables of the study is examined. The Spearman's bivariate correlations between basis of segmentation and the predictor variables are presented in Table 6.

Table 6. Spearman's rho Correlations (N=75)

	Basis of Segmentation	*ln(REV)*	*ln(EBIT)*	*ln(TA)*	*ln(TL)*
ln(REV)	-.069				
	.559				
ln(EBIT)	-.200*	.857**			
	.085	.000			
ln(TA)	.033	.870**	.812**		
	.779	.000	.000		
ln(TL)	.077	.893**	.835**	.862**	
	.512	.000	.000	.000	
ln(DEAM)	.012	.737**	.754**	.764**	.782**
	.916	.000	.000	.000	.000

**. Correlation is significant at the 0.10 level (2-tailed).*
***. Correlation is significant at the 0.01 level (2-tailed).*

Revenue, *ln(REV)*, and earnings before interests and taxes, *ln(EBIT)*, are negatively correlated with the LOB/product basis of segmentation. Total assets, *ln(TA)*, total liabilities, *ln(TL)*, and depreciation and amortization expenses, *ln(DEAM)*, are positively correlated with LOB/product basis of segmentation. The correlations between the predictors and the criterion variables are weak and not significant, except for *ln(EBIT)* which is moderate and significant. For example, basis of segmentation is correlated at absolute value of .069, .033, .077, .012 with *ln(REV)*, *ln(TA)*, *ln(TL)*, and *ln(DEAM)*, respectively. At the .1% level the Spearman's correlation suggests that only earnings before interests and taxes, *ln(EBIT)*, appears to be moderately significantly correlated with LOB/product basis of segmentation. This is expected considering the proprietary cost theory implicated by Aleksanyan & Danbolt (2015), Botosan & Stanford (2006), Tsakumi *et al*. (2006), Berger & Hann (2007), Leuz & Verrechia (2000), and Verrecchia (1983).

The high significant correlations among/between the predictors tend to suggest that there is multicollinearity among the variables. However, correlation coefficients alone are not sufficient to prove multicollinearity. Multicollinearity checks are performed in the next section.

Multicollinearity checks

Multicollinearity checks for the high correlations among the financial variables are now carried out, first using the variance inflation factors (VIFs) of the predictors. The VIFs are within acceptable limit. Theoretically, Hair, Black, Babin & Anderson (2009) and Neter, Wasserman & Kunter (1990) suggest that multicollinearity is a problem when VIF on any independent variable is greater than 10. Condition index is also used to check for collinearity. The condition index test result ranged from 1 to 8.156. Collinearity diagnostic (table not shown due to space constraint) indicates that collinearity is within the theoretically acceptable thresholds of between 15 and 30. The next section considers the multivariate test results.

Multivariate test results

As mentioned elsewhere above, the multivariate tests excluded five companies that had negative earnings before interests and taxes. The result of the tests is presented in this section, starting with that of the first hypothesis.

Test on hypothesis 1, H1

Binomial logistic regression is carried out to test the alternative hypothesis that there is likelihood that operating segments prior year's financials can affect the choice of basis of segmentation. The test results are presented in Table 7. Model 1 of Table 7 is the full model containing all the predictors while Model 2 is without the control variable, total assets, *ln(TA)*. The result shows two of the independent variables making unique statistically significant contributions to basis of segmenting operating units. These are earnings before interests and taxes, *ln(EBIT)*, and total liabilities, *ln(TL*). These variables' results suggest there is a significant likelihood that companies will segment either on LOB/product basis or geographic basis. Based on the paper's segmentation dichotomy, if companies do not segment on LOB/product basis they will do so on geographic basis.

Since *ln(EBIT)* is significant and negative, and given that LOB/product is the reference category, it means that companies that have high earnings before interests and taxes are not likely to segment on LOB/product basis but rather on geographic basis. In other words, a significant increase in the magnitude of earnings before interests and taxes has the effect of decreasing LOB/product segmentation basis. Consequent upon a decrease in LOB/product segmentation basis, there is the likelihood of increased segmentation on geographic basis. With proprietary cost in mind, it stands to reason that there may not be proprietary cost when companies segment on geographic basis, as a result of increase in

earnings before interests and taxes. *ln(TL)* is positive and significant at the .05 level in Model 1, and at the .01 level in Model 2.

Table 7. Binomial logistic regression to predict the likelihood of segmenting on LOB/product basis

ln(REV) = Natural log of revenue from sales to external customers. ln(EBIT) = Natural log of earnings before interests and taxes. ln(TA) = total assets. ln(TL) = Natural log of total liabilities. ln(DEAM) = Natural log of depreciation and amortization expenses. t = 2015, t-1=2014.

$Prob(LOB)_t = \alpha + \eta_1 ln(REV_{t-1}) + \eta_2 ln(EBIT_{t-1}) + \eta_3 ln(TA_{t-1}) + \eta_4 ln(TL_{t-1}) + \eta_5 ln(DEAM_{t-1})$ .. Model 1

$Prob(LOB)_t = \alpha + \eta_1 ln(REV_{t-1}) + \eta_2 ln(EBIT_{t-1}) + \eta_3 ln(TL_{t-1}) + \eta_4 ln(DEAM_{t-1})$ …... Model 2

		Model 1			Model 2		
Basis of segmentation[a]		B	Wald	Sig.	B	Wald	Sig.
Geographical segmentation	Intercept	9.666	5.142	.023**	7.928	4.023	.045**
	$ln(REV_{t-1})$	-.270	.263	.608	-.364	.447	.504
	$ln(EBIT_{t-1})$	-1.703	8.319	.004***	-2.066	12.878	.000***
	$ln(TA_{t-1})$	-2.090	2.626	.105			
	$ln(TL_{t-1})$	3.173	6.291	.012**	1.511	8.997	.003***
	$ln(DEAM_{t-1})$	.444	1.728	.189	.499	2.497	.114
	Cox and Snell R^2		.383			.359	
	Nagelkerke R^2		.551			.517	
	-2 Log likelihood		52.737			55.619	

***, **. *Test is statistically significant at the 0.01, 0.05 levels (2-tailed).*

[a]. The reference category is LOB/product segmentation basis.
Model 1 = Full model containing all independent variables. Model 2 = Control model

This suggests that an increase in total liabilities, *ln(TL*), has significant effect of increasing LOB/product basis. Consequent upon the increase in LOB/product basis of segmentation, there will be a significant likelihood of a decrease in geographic basis of segmentation. It stands to reason that there is proprietary cost when companies segment on geographic basis because of increase in total liabilities. It is possible that competitors will know the weak geographical area(s) of their opponent to attack.

Total revenue and total assets are negative and not statistically significant. Their observed signs suggest they can reduce LOB/product basis of segmentation while increasing the geographic basis. The sign of depreciation and amortization expenses, *ln(DEAM)*, suggests it is likely to increase LOB/product basis of segmentation; however, it has no significant likelihood of doing so. Regarding the explanatory power of the models, Cox and Snell, and Nagelkerke pseudo R-Square suggests, respectively, that the operating segments financials used in this paper explain up to about 40% and 55% of the variation in the decision to segment on LOB/product basis. The inclusion of total assets, *ln(TA)* in

Model 1, decreased -2 Log likelihood from 56 to 53, indicating improvement of Model 1 over Model 2.

Test on hypothesis 2, H2

The hypothesis that operating segments prior year's financials increases the number of operating segments created is tested next. Table 8 presents the results of OLS regression results. Earnings before interests and taxes, *ln(EBIT*), and depreciation and amortization expenses, *ln(DEAM)*, are statistically significant at the .01 level. Specifically, earnings before interests and taxes, *ln*(*EBIT*), is negative and significant in both models at the .01 level. This suggests that increases in earnings before interests and taxes are likely to subsequently reduce the number of operating segments created by CODMs. Depreciation and amortization expenses is positive and significant in both models at the .01 level also. This suggests that increases in depreciation and amortization expenses will likely increase the number of operating segments to be created by CODMs. In Table 8 there is no evidence to suggest that revenue, total assets and total liabilities significantly affect the number of operating segments to be created.

Table 8. Multivariate regression of segment financials and number of operating segments

ln(REV) = Natural log of revenue from sales to external customers. ln(EBIT) = Natural log of earnings before interests and taxes. ln(TA) = total assets. ln(TL) = Natural log of total liabilities. ln(DEAM) = Natural log of depreciation and amortization expenses. t = 2015, t-1=2014.

$NSEG_t = \alpha + \eta_1 ln(REV_{t-1}) + \eta_2 ln(EBIT_{t-1}) + \eta_3 ln(TA_{t-1}) + \eta_4 ln(TL_{t-1}) + \eta_5 ln(DEAM_{t-1})$ ….. Model 1

$NSEG_t = \alpha + \eta_1 ln(REV_{t-1}) + \eta_2 ln(EBIT_{t-1}) + \eta_3 ln(TL_{t-1}) + \eta_4 ln(DEAM_{t-1})$ ….. Model 2

	Model 1			Model 2		
	B	t	ρ	B	t	ρ
Intercept	3.424	1.925	.058*	3.153	1.909	.060*
$ln(REV_{t-1})$	.324	1.227	.224	.308	1.185	.240
$ln(EBIT_{t-1})$	-.655	-2.680	.009**	-.675	2.829	.006**
$ln(TA_{t-1})$	-.150	-.426	.672			
$ln(TL_{t-1})$	.085	.244	.808	-.027	-.120	.905
$ln(DEAM_{t-1})$	.538	2.851	.006**	.538	2.868	.005**
R^2		.162			.160	
Adjusted R^2		.101			.112	
Number of observations		75			75	

*, **. *Test is statistically significant at the 0.1and 0.01 levels (2-tailed)*

Model 1 = Full model containing all independent variables. Model 2 = Control model

In sum, a juxtaposing of Tables 7 and 8 shows that earnings before interests and taxes, total liabilities and depreciation and amortization expenses matter when CODMs are

deciding to choose a particular basis of segmentation, and when they are deciding to create additional operating segments. Together, the independent variables explain up to about .162 (adj. R^2, .101) of the variation in the number of operating segments created by chief operating decision makers.

V. CONCLUSION

This paper investigates the likelihood of Nigerian companies using one-year lagged operating segments financials to predict the choice bases of segmenting operating segments. The result shows that the likelihood exists that earnings before interests and taxes, and total liabilities significantly affect the choice of basis of segmentation of operating units in Nigerian quoted companies. In particular, we find that companies with high positive earnings before interests and taxes are likely to segment on geographic basis rather than on LOB/product basis. That is to say that a significant increase in magnitude of earnings before interests and taxes has the effect of decreasing LOB/product segmentation basis in Nigerian companies. The result shows that total liabilities are positive and significantly affects the choice of LOB/product basis of segmenting operating units. The likelihood exists that a significant increase in total liabilities increases LOB/product basis of segmentation and decrease geographic basis of segmentation. The signs of total revenue and total assets are negative but not statistically significant. The sign of depreciation and amortization expenses suggests it increases LOB/product segmentation, however, it is not significant. Cox and Snell and Niekerk pseudo R^2 suggests, respectively, that the operating segments financials together explain up to about 40% and 55% of the variation in the decision to segment on LOB/product basis. These results are contained in Table 7. The paper also investigates the relation between one-year lagged operating segments financials and the number of operating segments created consequently. At the .01 level, the documented evidence suggests that earnings before interests and taxes, and depreciation and amortization expenses significantly affect the number of operating segments created. Specifically, an increase in earnings before interests and taxes is likely to reduce the number of operating segments created by the CODM. This finding suggests that increase in depreciation and amortization expenses is likely to increase the number of operating segments to be created. There is no evidence that revenue, total assets and total liabilities collectively or individually significantly affects the creation of more operating segments in Nigerian companies. This result can be seen in Table 8. In sum, reading Tables 7 and 8 together shows that earnings before interests and taxes, total liabilities and depreciation and amortization expenses matter when CODMs are deciding to choose a particular basis of segmentation, and when they are deciding to create additional operating segments.

Based on these findings, we recommend that chief operating decision makers of Nigerian companies should take into consideration the magnitude of earnings before interests and taxes, total liabilities, and depreciation and amortization expenses when trying to choose a

basis of segmenting operating units and when trying to carve out addition number of operating segments. This is a major contribution of the paper.

As a caveat, concern can be raised as to whether two years' financial data on 75 non-finance public companies in Nigeria are sufficient to generalize to a richer dataset, and/or to other countries, emerging or developed. The results and conclusions of this paper are valid only for the industries used in the study. Future research may wish to increase the number of years, and to use other companies'/countries' data.

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