

Application of Quantitative Techniques and Performance of Small and Medium Enterprises (SMEs) in Nigeria

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Abstract— The study was conducted to examine the influence of quantitative techniques application on performance of SMEs in Nigeria. The survey research design was adopted in this study because data were collected using primary technique. SMEs in Uyo metropolis were considered for the study. The population of this study was made up of one thousand and ninety-three (1093) SMEs in Uyo metropolis, Akwa Ibom State. The sample size was determined using Taro Yamene's approach which was two hundred and ninety-three (293). Data were collected using questionnaire structured. The dependent variable was Performance (PF) while the independent variables were quantitative techniques represented by Linear Regression (LR) and Linear Programming (LP). From the outcomes of the analyses, it was discovered that LR,LP had positive and significant influence on PF of SMEs in Uyo metropolis. It was concluded that quantitative measures application had positive and significant influence on performance of SMEs in Nigeria. However, it was recommended that more quantitative measures should be applied in SMEs for the purpose of raising the performance indicators of the enterprises.

Keywords— SMEs, Performance Indicators, Quantitative Measures.

I. INTRODUCTION

Small and medium scale enterprises (SMEs) are entities that drive the economic growth and development of Nigeria. The role of these enterprises in economic growth and development is achieved through the level of growth in performance achieved over the years (Anene and Oyelere, 2014). In other words, the level of performance of SMEs in Nigeria describe the level of economic growth and development of the country as well. The progress in performance of SMEs is tied to many factors which are quantitative and qualitative in nature. The qualitative factors are those factors that are without the attributes of measurement and the quantitative factors are those factors that could be measured using values or figures (Bagshaw, 2019). Quantitative measures are some of these quantitative factors that could influence performance of SMEs in Nigeria when applied and used properly.

In antecedent time, the decisions taken by managers were mostly without the application of mathematical models but interpreted manually. During this period, the economy of different countries was considered to be in primeval stage for the fact that there was no technological innovations and progression. During the primeval era, ideas were hardly transformed into invention that could bring about greater advantage to the organization (Devi & Devaki, 2019). Since the economy of countries had been developed through inventions of techniques to solve boring problems, organizations have been encouraged to take advantage of these inventions to raise their performance. Quantitative models are some of these inventions brought by experts to solve challenging issues that are quantitative in nature in organizations like SMEs in Nigeria.

The quantitative measures invented by scholars include linear programming, linear regression, break-even analysis and so on. All these techniques are expected to be effectively used by managers of SMEs in Nigeria to drive their performance (Fuller, 2015). Despite these quantitative measures, SMEs in Nigeria are still applying the usual ways of analysing decision problems even though they have adopted quantitative measures.

Performance is defined as the level of growth in certain attribute regarded as performance indicators. These attributes include revenue, profitability, employee's productivity and investment. Thus, when talking about performance of SMEs in Nigeria, it is possible to say that performance has no common definition or meaning but it could be explained based on certain parameters which have been mentioned (Verma and Sharma, 2017). For there to be improvement in performance, both qualitative and quantitative factors, must be put together. Studies in this area surveyed by the researchers have not really dwell on the influence of the individual quantitative measure on performance especially SMEs in Nigeria. This study is set to achieve what have not been covered by previous researchers in this area.

SMEs in oversea have adopted different quantitative measures to analyse their decision problems and the outcome of the application have impacted positively on their performance (Ukata, 2017). In Nigeria, SMEs have decided to adopt the ideas of the counterparts in adopting quantitative measures to solve the challenging issues of decisions taken by managers. However, some of these enterprises that have adopted quantitative measures in Nigeria have been reporting growth in their performance while others are still reporting poor performance despite the application of quantitative measures including SMEs in Uyo metropolis (Ezema and Amakon, 2012). Some of the SMES in Nigeria have not even adopted quantitative measures in solving decision problems. It appears

that the importance of using quantitative measures have not been divulged to the managers of these enterprises.

Some of the SMEs in Nigeria that have adopted quantitative measures in their operations are still not doing well in terms of performance because of the skills to make proper use of these measures. It is on this note that the researcher is in doubt whether quantitative measures applied by SMEs in Nigeria has any influence on their performance by considering SMEs in Uyo metropolis.

The main objective of this study was to certain the influence of quantitative measures application on performance of SMEs in Nigeria-A study of Uyo metropolis, Akwa Ibom State.

II. REVIEW OF RELATED LITERATURE

2.1 Conceptual Review

SMEs have been defined in various ways and there is no generally accepted definition of small business because the classification of business into large-scale or small-scale is a subjective and qualitative judgment (Adewoye and Akanbi, 2012). In Nigeria, there is no clear- cut definition that distinguishes a purely small-scale enterprise from a mediumscale enterprise. The Central Bank of Nigeria in its Monetary Policy Circular No. 22 of 1998, defined SMEs as having an annual turnover not exceeding ¥500,000. The National Economic Reconstruction Fund (NERUND) put the ceiling for small-scale industries at 10 million naira. Section 37b (2) of the Companies and Allied Matters ACT of 1990 defined a small company as one with: an annual turnover of not more than N2,000,000; and net asset value of not more than N1,000,000 (Mahmoud, Umar and Usman, 2014). With regards to the economic definition a firm is regarded as small if it has relatively small share of their market place, managed by owners or part owners in a personalized way and not through the medium of a formalized management structure; is independent in the sense of not forming part of a large enterprise.

With the establishment of Small and Medium Enterprises Equity Investment Scheme (SMEEIS) by the CBN in 1999, the bankers committee in 2006 defined Small and Medium Enterprise as any enterprise with a maximum asset base of N1.5billion (excluding land and working capital), and with no lower or upper limit of staff. SMEs is based on an enterprise's number of employees, the level of assets, sales turnover of the said enterprise or a combination of these criteria in most countries (Agboh, 2015). Despite the varying perspectives in the above definitions researchers are in agreement in indicating that Small and Medium Scale Enterprises (SMEs) are defined in terms of size or market share; capital base; numbers of employees; turnover and asset value among others. Arguably these characteristics of the small and medium scale enterprise affect the level of application of quantitative measures in the economy of Nigeria. Accordingly, Akomea-Bonsu and Sampong (2012) agreed and acknowledge that there are many factors that make SMEs different, such as turnover, industry, number of employees and format of business. These factors need to be studied in more detail to establish how they influence the adoption process of ICT.

In Nigeria SMEs represent the model of socio-economic policies of government, which emphasis on the job creation at

all levels of income stratum and diffusion of economic power in the hands of few thereby discouraging monopolistic practices of production and marketing and in all prospects contributing to growth of economy and foreign exchange earning with low import intensive operations (Olusegun, 2016). SMEs also play a significant role in economic growth and development through high contribution to domestic production, significant export earnings, low investment requirements, operational flexibility, location wise mobility, low intensive imports, capacities to appropriate indigenous technology, develop import substitution, contribution towards production, technology oriented industries, competitiveness in domestic and export markets thereby generating new entrepreneurs by providing knowledge and training (Rufai, 2014).

Accordingly, small business may be defined as an enterprise operating with limited amount of capital small in size in its area of operation and limited number of employees such that its limited assets and liabilities could not really qualify its management to obtained loan from financial institutions. In any nation, small-scale industries play very significant economic role in generating employment for rural communities of the society and other benefits which can hardly be generated from large firms (Murat and Opusunju, 2017). Around the world, economy of every nation has improved dramatically as a result of small business development which has put the nations in a better position in globalizations.

Businesses that fall under small and medium scale are grouped into small businesses such as firewood supply, packaging of food items, meat retailing, plantain production, restaurant service, small scale poultry raising, rabbit raising, organizing labour squad, operating a nursery school for children, home service, arranging food for parties and host of others. Business grouped under medium scale are soap production, aqua culture/fish farming, chalk making, foam production, nylon production, concrete block production, hair/body cream productions, chemical production, commercial poultry, professional practice claw, accountancy, education, food and beverage production among others (Mary *et al*, 2015).

The survival of all these enterprises is associated with the level of performance attained by the organization. Thus, performance of SMEs is very fundamental to the continuous existence of these firms. Performance is defined as the level of improvement in financial and non-financial indicators (Verma and Sharma, 2017). Performance is also defined as the level of growth in both quantitative and qualitative factors. In this case, it is observed that performance has to do with the extent to which have achieved their goals and objectives. Performance is anchored on the level of improvement of some factors as stated earlier which could be financial and non-financial in nature. The financial factors of performance are those attributes that are often presented on financial statements published by managers of SMEs in Nigeria while the non-financial factors are those attributes that are not presented on published financial statements of SMEs in Nigeria (Wazis, Imam & Kashim, 2016).

The financial factors of performance are also regarded as quantitative factors of performance because of the characteristics of being measurable with values or figures. On the contrary, some of the non-financial factors of performance are quantitative and others are qualitative in nature. The quantitative factors of non-financial performance are those attributes although not reported on financial statements published by managers of SMEs in Nigeria but can be translated into quantifiable attributes (Bagshaw, 2017). For instance, the number of hours spent by employees in production of certain product could be regarded as quantitative nonfinancial indicator because the number of hours spent, and the quantity of goods produced could be translated into quantifiable data.

Qualitative non-financial performance are those attributes that lacks the characteristics of being measurable with quantifiable data. Qualitative non-financial performance are those factors that could not be measured by assigning numbers to but are existing in an organization (Wazis *et al.*, 2016) Example of qualitative non-financial performance are decisions often taken by managers, the skills of individual directors in an organization and the experience acquired by employees in an organization. Qualitative non-financial performance, when properly managed, usually raise the overall growth of an entity.

Performance in this study is considered from the standpoint of measurability of actions. Thus, performance of SMEs in Nigeria especially that of champion brewery Plc, Uyo is connected to growth in revenue, growth in profitability, growth in investment of non-current assets, improvement in employees' efficiency and improvement in value. Growth in revenue has to do with increase in sale or turnover of an entity between two accounting periods (Ukata, 2017). In this case, when revenue falls between two accounting periods, growth in revenue could be described as being negative and thus, performance between the two accounting periods is not impressive. Increase in profitability is described as a fundamental achievement in performance of firms.

It is also important to note that growth in profitability might not really indicate that have attained progress in performance especially when managers adopt the approach of earnings management where expenses are reduced or when a greater proportion of sale revenue is done on credits (Fuller, 2015). In this case, it could be stated clearly that SMEs in Nigeria could declare paper profits which might not really portray the image of performance of the firms. For profit to affect performance of positively, quality of profit is expected whereby a greater proportion of the profits is on cash and the negative effect of earnings management is minimized.

Investment in non-current assets usually describe the extent to which a company is expanding. The higher the investment in acquisition of non-current assets, the larger the entity and vice versa (Verma and Sharma, 2017). The level of investment in which a SMEs firm commits funds into defines the propensity of the company growing larger in the future. Employee's efficiency is very important in ensuring the growth in performance of an entity. Employee's efficiency has to with the possibility of employees utilizing less hours to [produce larger volumes of product. In the case, employee's efficiency is capable of driving the performance of SMEs in Nigeria (Onukwuli et al., 2014). Growth in value usually defines the performance of an entity, value of a SMEs company in Nigeria could be described in terms of growth in stock price, growth in assets, growth in book value of equity and growth in market of equity.

Performance of SMEs in Nigeria in this study is measured in terms of growth in revenue, growth in profitability, improvement in investment and growth in value. This is because all these factors mentioned are reported on financial statements of SMEs in Nigeria as well as disclosing them in annual reports (Bagshaw, 2019). The reason behind the choice of quantitative indicators reported on annual reports and financial statements SMEs in Nigeria is owing to the fact that the independent variables is concerned with quantitative measures.

Ouantitative measures that has been introduced to be utilized in the operations of SMEs in Nigeria include linear programming, linear regression and break-even analysis. Linear programming is defined as a quantitative measure usually adopted to solve a decision problem the has more than one limiting factor (Anene and Oyelere, 2014). Linear programming is usually adopted to solve the problem of allocation to enable the user to appropriately ascertain the best combination of allocations that could yield meaningful results. The benefits of adopting linear programming quantitative measure is to assess the optimal combination of activities or products that could yield the highest outcome to the user. Linear programming is often to assess the best combination of more than one product that could either maximize profit or minimize cost. Also, linear programming is also used to assess the combination of labour hours that could produce maximum quantity of products as well as combination of products that could be produced using minimum hours (Fuller, 2015).

For the fact that linear programming is often adopted in assessing the best combination of products known as optimal products, it is clear to say that linear programming, as one of the quantitative measure, is adopted in SMEs because of its suitability in decision making which has to do with profit maximization, cost minimization, output maximization and labour hours minimization (Bagshaw, 2019). Thus, the application of linear programming in operations of SMEs in Nigeria is targeted towards raising performance of the. Linear programming is applicable in various areas of management science such as accounting and finance, marketing and distribution, human resource management and production.

Linear programming is adopted in accounting and finance department of an organization particularly in assessing the optimality of investments (Fuller, 2015). The application of linear programming in the area like capital budgeting assist managers of SMEs in Nigeria to decide the investments that are ideal, and which can add more value to the wealth of the shareholders. Also, in the area of accounting and finance, linear programming is used to solve the problem of capital rationing in an organization which is drawn from investment perspective (Devi and Devaki, 2019). Usually, a SMEs company might be faced with different investment opportunities with positive Net Present Value (NPV) with different amount of initial capital outlay and the company might be constrain in terms of available capital to invest in all these investments with positive Net Present Value (NPV). In this case, linear programming could



be used to allocate appropriately or to decide the investments to be combined to yield meaningful result to the organization.

Linear programming is adopted in marketing and distribution activities of a SMEs company. it is basically used to allocate the quantity of products to produce to different market based on size of the market and the available resources in the organization with the aim of reducing waste. Linear programming is also adopted in marketing and distribution activities of a SMEs entity to help managers to assess the markets with higher patronage. It is also adopted in distribution activities to ascertain the route to advertise company products or to deliver the products with minimal costs (Onukwuli et at., 2014). Linear programming as a quantitative measure is also used in research and development activities of an organization to enable the user or manager to determine quantitatively the level of satisfaction derived from the company's products as well as locating new markets for the company's products.

Linear programming is applicable in human resource department of an organization. Particularly, it is used to evaluate the efficiency of employees in terms of labour hour usage. It is usually adopted to determine the combination of employees that could produce the maximum quantity of products needed in an organization with limited hours and limited costs (Ukata, 2017). The application of linear programming in human resource management is achievable when the user understands how the models work. The use of linear programming in human resource management also help managers of SMEs to select the best employees that could handle the activities of the organization efficiently and effectively to raise the performance. This is achievable in recruitment process often conducted by a SMEs company in Nigeria.

Linear programming is employed in production department of a SMEs company. The essence of its adopting is to ascertain the combination of hours that could yield maximum output given the limited resources or input. The application of linear programming is basically suitable in SMEs process where raw materials are transformed into finished goods or products (Verma and Sharma, 2017). Linear programming is also applied to decide the quantity of input to combine to produce the maximum quantity of products at a given period of time. This is mostly applicable in a SMEs company where there are varieties of products often produced by the organization. Linear programming is also adopted in production department to ascertain the combination of products that could yield higher turnover or revenue.

However, linear programming is a quantitative measure that has some limitations based on its applicability. These limitations include: first, linear programming cannot be applied to solve a problem that has one limiting factor or scarce resource. Second, linear programming cannot be applied in a scenario that is full of uncertainties (Wazis et al., 2016). The application of linear programming does not warrant the exact outcome calculated using objective function because of the historical data used. Finally, linear programming model is not suitable in production of one product. To adopt linear programming, there are basic steps that are must be followed. These steps include:

- i. Define the variables in accordance with the products
- ii. State the objective function either to minimize costs or to maximize profits for instance.
- iii. Formulate the constrain in line with their limited resources.
- iv. State the non-negativity function.

It is important to note that in maximization of profits, the less than or equal to () symbol should be used and to minimize costs, the greater than or equal to (?) symbol should be used. To obtain the optimal value from the linear programming model to substitute in the objective function, the constrain must be converted into equation and solved appropriately using a specified method. Basically, there are two methods used in solving linear programming problems and they are graphical method or algebraic method. The graphical method is only used to solve a linear programming problem that has just two variable- X and Y for instance. The algebraic method could be used to solve different kind of linear programming problems. It includes matrix method, determinant (Cramer's rule) and simplest tableau method. The matrix, determinant and simplest methods could be used to solve linear programming problems involving just two variables and above.

Linear regression is another quantitative measure used to solve decision problems in SMEs in Nigeria. linear regression is used mostly to solve the problems that has to do with dependent and independent variables. In other words, in the application of linear regression, the essence is to establish the rate of influence of independent variables on dependent variables (Ezema and Amakon, 2012). Linear regression is a statistical tool that is mostly used in prediction of one quantity or variables given the other.

Linear regression has some assumptions which are often satisfied before the adoption. These assumptions include: first, the data for both dependent and independent variable must exhibit the attribute of normality. Second, the independent variables must influence the dependent variable individually to avoid the problem of multi-collinearity (Bagshaw and Nissi, 2019). Finally, the dependent variable must be predicted by the independent variables to avoid the problem of first-order autocorrelation.

Before the adoption of linear regression, the user should be familiar with the requirements which has to do with the variables, the assumptions and the expected result (Bagshaw, 2017). This simply means that before linear regression is adopted to solve a problem in a SMEs company, the dependent and independent variable must be accurately stated, and the assumption of normality and others must be strictly adhered. When all these requirements are satisfied, the result provided by linear regression could be said to be authentic and not with high level of spuriousness.

Like linear programming, linear regression is applicable in the following areas or departments in a SMEs company such as finance and accounting, marketing department, human resource and production department. Linear regression is basically adopted in accounting and finance department especially in the prediction of costs which cut across various areas and practices of the department (Verma and Sharma, 2017). Linear regression is also adopted in marketing department for the purpose of



predicting the quantity of products manufactured by a firms that could be patronized in a given market given other conditions to be favourable like taste of the buyers, price of the product, then nature of the product and political stability.

Linear regression is applicable in human resource department of a SMEs company in Nigeria. The essence of the adopting of linear regression in human resource department rest on prediction (Devi and Devaki, 2019). Linear regression could help managers of human resource department to predict the number of outputs that could be produced with the available labour hours. Linear regression is also employed in production department for the purpose of predicting the cost of raw materials that could be used to acquire the suitable raw materials that could produce certain number of products at a given period. The essence of adopting linear regression in prediction is to solve decision problems which could influence performance of SIVIEs in Nigeria positively.

Break-even analysis is another quantitative measure used in taking decision in an organization. In break-even analysis, the major concern of a manager is to ascertain a point where profit is zero and cost is zero. In this case, break-even point is a point of equilibrium between total revenue and total cost of an entity. The total revenue is derived by multiplying the price charge with the quantity of products (Fuller, 2015). Total cost is broadly classified into total fixed cost and total variable cost. In the computation of break-even point, certain factors must be taken into consideration and these include selling price per unit, variable cost per unit and total fixed cost. Break-even point in quantity usually indicate the quantity of products that could be manufactured by a firm to more no profit and no loss.

Break-even analysis is usually used by managers to determine the point of equilibrium between revenue and total cost so as to decide the quantity of product to produce further at a given price and variable cost per unit to maximise profit (Bagshaw, 2019). This is how important break-even analysis is in SMEs in Nigeria. In deciding the quantity of product to produce beyond break-even point to maximize profit, performance of SMEs in Nigeria could be influenced positively.

2.2 Theoretical Review

A theory was review and adopted in the study because of its suitability in the study conducted

2.2.1 Resource-Based Theory

The resource-based theory was formulated and developed by Barney (1995). The resource-based theory emanates from the principle that the source of firm's competitive advantage lies in their internal resources, as opposed to their positioning in the external environment. That is rather than simply evaluating environmental opportunities and threats in conducting business, competitive advantage depends on the unique resources and capabilities that a firm possesses (Barney, 1995). The resource-based approach of the firm predicts that certain types of resources owned and controlled by firms have the potential to generate competitive advantage as well as superior firm performance (Devi and Devaki, 2019). Quantitative measures applied in SMEs could be regarded as resources controlled by the organization for the purpose of improvement in performance. The resource-based approach stipulates that in strategic management the fundamental sources and drivers to firms' competitive advantage and superior performance are mainly associated with the attributes of their resources and capabilities which are valuable and costly-to- copy. Firm resources include all assets, capabilities, organizational processes, firm attributes and information, knowledge controlled by a firm that enable the firm to conceive and implement strategies that improve its efficiency and effectiveness (Barney, 1995). Quantitative measures applied by SMEs are included in organizational processes used in conducting business activities. This is how relevant resource-based theory is in this study. Thus, it is adopted in this study.

2.3 Empirical Review

Previous studies in relation to this study were reviewed to ascertain the gap in the present study.

Monday et al. (2015) assessed strategic management and firm performance: A study of selected manufacturing companies in Nigeria. The intention of the researchers was to provide further evidence on the effects of strategic management (SM) on the performance of manufacturing industries in Nigeria. Five large-scale quoted manufacturing firms located in Lagos metropolis were selected. The study relied on primary data which were obtained using structured questionnaire administered to 50 purposively selected respondents of the selected firms. The data collected were analysed using Analysis of Variance (ANOVA) and correlation analysis as well as descriptive analysis in pursuance of the stated specific objectives of the study. The result showed that strategic management had significant effects on the profitability and operational performance of the selected manufacturing firms. Also, strategic management had positive relationship with the level of competition of the firms. The study concluded that the practice of strategic management is sine qua non in boosting firm performance in the manufacturing industries in Nigeria.

Ukata (2017) in a study to investigate the use of quantitative business models as an aid for financial management by entrepreneurs to surmount Nigeria' s economic challenges. The investigation used causal comparative research design. The research design sought to find out that which is associated with certain occurrence, conditions, and outcomes types of behaviour by analysis of the past events, or already existing records. It was discovered that quantitative business models like price earnings ratio, dividend-discount-model, discount-cashflow-model, Pie in 3 -D, price-to-cash-flow-ratio, cost-benefitanalysis, breaking-even-analysis, statistics analysis of feasibility study, gross-domestic-product (GDP), and contribution margin (marginal income) were used as an aid for financial management in the areas of investments decisionmaking to clients, financial projection of potential future performance of firms, determining stock valuation of companies in the same industries, to know sales rate/investment areas and expected returns of private and public firms.

Verma and Sharma (2017) conducted a study to determine the role of quantitative techniques in business and management. The purpose of the study was to discuss the various quantitative techniques and methods used in managerial decisions.



Quantitative techniques arc very powerful medium through which we solve uncertainty in decision making and enhance projectability and efficiency in the business. A systematic approach to decision making is complex because today's business and environment in which it is functioning are for more complex than in the past. For large business, a single wrong decision very painful but may also have ramifications in national economy.

Bagshaw (2019) conducted a review of quantitative analysis in production planning decisions using the linear programming model. The purpose of the study was to examine the role of quantitative analysis in production planning decisions. This draws from the observed imperatives of quantitative analysis in business decisions and its capacity for predictability and enhanced decision making given the increasingly complex nature of the business environment. The study therefore addressed the historical evolution of quantitative technique as an efficient and effective decision-making tool. The content of the study addressed commonly applied quantitative technique in manufacturing firms today which is, linear programming and its subsequent impact on production planning decisions. The results based on a congruence of views revealed that the 'bestfit" application of quantitative analysis models and tools can untangle the complexities of production and planning decision making process in order to achieve the organizational goal.

Devi and Devaki (2019) evaluated the applications of quantitative techniques in decision making of business organisation. In the business world, and in fact, in practically every aspect of daily living, quantitative techniques are used to assist in decision making. Quantitative techniques are used to assist in decision making. Managers must be able to use quantitative techniques in a confident and reliable manner. Accountants make decisions based on the information relating to the financial state of organization. Economists make decision based on the information relating to the economic framework in which the organization operates. Marketing staff make decisions based on customer response to product and design. Personnel managers make decisions based on the information relating to the levels of employment in the organization, and so on. Such information is increasingly quantitative, and it is apparent that managers need a working knowledge of the procedures and techniques appropriate for analysing and evaluating such information.

2.3.1 Gap in the Literature

From the empirical literature reviewed, it was observed that studies on quantitative measures application and performance of SMEs were limited considering the variables of this study and the area chosen for the study. For this reason, the present study on quantitative measures application and performance of SMEs in Nigeria using the variables of linear regression and linear programming as quantitative measures would contribute to knowledge and existing literature in this area of interest, hence, the need for the study.

III. METHODOLOGY

In this study, the researcher adopted the survey research design. This allowed the researcher to use questionnaire to obtain the opinion of the respondents on the influence of quantitative measures application on performance of SMEs in Nigeria by considering Uyo metropolis, Akwa Ibom State. The population of this study was the aggregate of the Small and Medium Scale Enterprises (SMEs), which was based on the information obtained from Ministry of Commerce and Industry, Akwa Ibom State. The total number of registered small and medium scale enterprises in Uyo, Akwa Thom state was one thousand and ninety-three (1093) SMEs. Thus, the population of this study was one thousand and ninety-three (1093) SMEs in Uyo metropolis, Akwa Thom State.

The sample size of this study was appropriately determined by the researcher with the use of Taro Yamane's formula (Taro, 1967). The sample size is computed below: The Taro Yamane's formula of 1967 is $n=N/[l+N(e)^2]$, where:

n = Sample Size

N = Population Size

e = Level of Significance

N = 1,093, e=0.05 and n=?

 $n = 1,093/[1+1,093(0.05)^2] = 1,093/3.7325$

n = 293.

The value of two hundred and ninety-three (293) SMEs was considered a good representation of the entire population of one thousand and ninety-three (1093) SMEs. The convenience sampling technique was used by the researcher in the study to choose the respondents to administer questionnaires to, since it was appropriate for the study.

Relevant data for this study were collected from primary source. The primary data were obtained with the aid of structured questionnaire, which were administered to the target respondents on the subject matter. The instrument used for data collection in this study was a structured questionnaire. The questionnaire was structured in such a way that the respondents were able to understand and provide relevant answers. This was why the five-point Likert scale of strongly agreed 5, agreed 4, disagreed 3, strongly disagreed 2 and undecided 1 was used. The questionnaire was structured in close-ended format.

The Cronbach's Alpha Statistics was used to test the reliability of the data collected for the study. The Cronbach's Alpha Statistics of 50% and above was considered significant by the researcher and thus the data being reliable.

The statistical tool used in this study to analyse the relevant data were descriptive statistics and the linear regression model. The study was on quantitative measures application and performance of SMEs in Uyo metropolis, Akwa Ibom State. In this case, the measurement and the *apriori* expectation for each of the independent variables on the dependent were presented on the Table 3.1 below:

| TABLE 3.1: | Variable | Description |
|--------------|-----------|-------------|
| 1110000.0.1. | v annabic | Description |

| | | | i i anabie Bebenption | |
|-----|-----------------------|------|-------------------------|-------------------------------|
| S/N | Variable | Abbr | Measurement | <i>Apriori</i> Expectation |
| | Performance | PF | Five-Point Likert Scale | - |
| | Linear Regression | LR | Five-Point Likert Scale | Positive |
| | Linear Programming | LP | Five-Point Likert Scale | Positive |
| | | | (| |

Source: Researcher's Compilation (2022)

Below were the models: $PF = \beta_0 + \beta_1 LR + \beta_2 LP + e_t$

Equation (3.1)



where: fl Intercept of PF and β_1 and β_2 =Coefficient of each of the independent variables; e=Random error terms. The model stated in 3.1 was meant to test the combined influence of the variables of quantitative measures on performance of SME in Uyo metropolis. In line with the specific objectives of the study, the following models were formulated:

| $PF = \beta_0 + \beta_1 LR + e_t$ | Equation (3.2) |
|-----------------------------------|----------------|
| $PF = \beta_0 + \beta_1 LP + e_t$ | Equation (3.3) |

The data obtained were analysed using descriptive statistics and inferential statistics. These methods of data analysis were suitable in this study because it allowed the establishment of influence of quantitative measures application on performance of SMEs in Nigeria. Hence, the regression analyses were carried out at 5% level of significance and decision rules were: Accept H_o and reject H₁ when P-value>0.05, accept H₁ and reject H_o when P-value< 0.05.

IV. DATA ANALYSIS AND FINDINGS

4.1 Data Analysis

In this section of the study, the numerous data collected were analysed and presented in accordance with the requirements stated vividly in section three of the study. *4.1.1 Reliability Test*

The reliability statistics were computed and presented on Table 4.1a and 4.1b:

| | ТА | BLE 4.1a: Reliability Statistics | | | | | | | |
|----|---|---|--------------|--|--|--|--|--|--|
| | Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | No. of Items | | | | | | |
| | 0.981 | 12 | | | | | | | |
| So | Source: Computed by the Researcher (2022) | | | | | | | | |

| TABLE 4 lb | Summary | of Items | Statisti |
|---------------|----------|----------|----------|
| 1110000 1.10. | Dummun y | or nome | Duundu |

| Items | Scale Scale Con Mean if Variance Sq Item if Item Iten Deleted Deleted Cor | | Corrected Squared Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|-------|--|---------|---|------------------------------------|---|
| LR1 | 80.9706 | 273.060 | 0.849 | 0.721 | 0.981 |
| LR2 | 81.0294 | 272.272 | 0.873 | 0.760 | 0.981 |
| LR3 | 80.9706 | 273.060 | 0.849 | 0.721 | 0.981 |
| LR4 | 81.0294 | 272.272 | 0.873 | 0.760 | 0.981 |
| LP1 | 81.4412 | 251.648 | 0.916 | 0.839 | 0.980 |
| LP2 | 81.1765 | 264.695 | 0.845 | 0.714 | 0.981 |
| LP3 | 82.0294 | 242.272 | 0.908 | 0.824 | 0.982 |
| LP4 | 81.7941 | 251.017 | 0.837 | 0.701 | 0.982 |
| PF1 | 81.0882 | 272.447 | 0.849 | 0.721 | 0.981 |
| PF2 | 81.6176 | 249.880 | 0.893 | 0.797 | 0.981 |
| PF3 | 81.2647 | 266.079 | 0.801 | 0.642 | 0.981 |
| PF4 | 81.0294 | 272.272 | 0.873 | 0.760 | 0.981 |

Source: Computed by the Researcher's (2022)

From Table 4.1, the Cronbach's Alpha statistics indicated a higher value of 98.1% which showed that the data collected from the respondents with questionnaire for the study using Likert scale could be relied upon.

4.1.2 Descriptive Statistics

To examine the attributes of the essential data collected for the study, descriptive statistics were computed for all the variables and presented on Table 4.2.

From Table 4.2, Performance (PF) of SMEs in Uyo metropolis had range, minimum, maximum, mean and standard deviation of 1.00, 4.00, 5.00, 4.7125 and 0.4475 respectively.

The range showed the difference between the maximum and minimum value of PF as 1.00, the minimum indicated that the least value of responses obtained in relation to PF was 4.00, the maximum showed that the highest value of PF was 5.00, the mean indicated that the average value of PF from the responses was 4.7125 and the standard deviation of 0.4475 indicated that the variation between the data set for PF from the mean value was not high from the responses obtained. The observations of two hundred and ninety-three (293) was equal the sample size of this study.

| TABLE 4.2: Descriptive Statistics | | | | | | | | | |
|-----------------------------------|------------------------------|------|------|------|--------|--------|--|--|--|
| Variable | iable N Range Min. Max. Mean | | | | | | | | |
| PF | 293 | 1.00 | 4.00 | 5.00 | 4.7125 | 0.4475 | | | |
| LR | 293 | 1.25 | 3.75 | 5.00 | 4.6186 | 0.4881 | | | |
| LP | 293 | 2.25 | 2.75 | 5.00 | 4.5683 | 0.5651 | | | |

Source: Computed by the Researcher's (2022)

From Table 4.2, Linear Regression (LR) had range, minimum, maximum, mean and standard deviation of 1.25, 3.75, 5.00, 4.6186 and 0.4881 respectively. The range showed the difference between the maximum and minimum value of LR as 1.25, the minimum indicated that the least value of responses obtained in relation to LR was 3.75, the maximum showed that the highest value of LR was 5.00, the mean indicated that the average value of LR from the responses was 4.6 186 and the standard deviation of 0.488 1 indicated that the variation between the data set for LR from the mean value was not high from the responses obtained. The observations of two hundred and ninety-three (293) was equal the sample size of this study.

From Table 4.2, Linear Programming (LP) had range, minimum, maximum, mean and standard deviation of 2.25, 2.75, 5.00, 4.5683 and 0.5651 respectively. The range showed the difference between the maximum and minimum value of LP as 2.25, the minimum indicated that the least value of responses obtained in relation to LP was 2.75, the maximum showed that the highest value of LP was 5.00, the mean indicated that the average value of LP from the responses was 4.5683 and the standard deviation of 0.5651 indicated that the variation between the data set for LP from the mean value was not high from the responses obtained. The observations of two hundred and ninety-three (293) was equal the sample size of this study. 4.1.3 Check of Multi-Collinearity

To examine the existence of multi-collinearity in all the independent variables of the study, the Tolerance and Variance Inflation Factor (VIF) were calculated for each variable and presented by the researcher on Table 4.3:

| | TABLE 4.3: Multi-Collinearity Check | | | | | | | | |
|------|-------------------------------------|----------------|---------------------------------|--|--|--|--|--|--|
| | Variable | Tolerance | Variance Inflation Factor (VIF) | | | | | | |
| | LR | 0.560 | 1.786 | | | | | | |
| | LP | 0.560 | 1.786 | | | | | | |
| urce | Computed l | ov the Researc | her's (2022) | | | | | | |

*Dependent Variable=PF

From Table 4.3, it was observed that there was no multicollinearity in each of the independent variables as the Tolerance for each was greater than 0.1 benchmark and the VIF was not greater than 10 as well.

So

4.1.4 Simple Correlation

A further check of the existence of multi-collinearity among the pairs of two independent variables was conducted on the data set using simple correlation as presented on Table 4.4:

| TABLE 4.4: Simple Correlation | | | | | | | | |
|-------------------------------|--------|---------|-------|--|--|--|--|--|
| Varia | ble PF | LR | LP | | | | | |
| PF | 1.00 | 0 | | | | | | |
| LR | 0.86 | 0 1.000 | | | | | | |
| LP | 0.79 | 4 0.046 | 1.000 | | | | | |
| | | | | | | | | |

Source: Computed by the Researcher's (2022)

From Table 4.4, it was observed that the relationship that existed between one independent variable and the other was below 50%, thus, it indicated the absence of the existence of multi-collinearity as stated on Table 4.3.

4.1.5 Test of Hypotheses

The hypotheses of the study were tested with the use of tstatistics, probability value (pvalue) and F-ratio as criteria for accepting or rejecting any of the hypotheses (null or alternative hypothesis) computed using linear regression.

Hypothesis One

The simple linear regression statistics were computed and presented on the Table 4.5:

| | | TABLE 4.5: Simple Linear Regression Output | | | | | | | |
|---------------------------|--------------|--|---------|---------|-------------|-------|----------------|--------------------|----------------|
| | Variable | Beta (ß) | t-Stat. | P-Value | Remark | R | \mathbb{R}^2 | Adj R ² | F-ratio |
| | Constant | 1.070 | 8.409 | 0.000 | Significant | 0.860 | 0.740 | 0.739 | 829.117 p<0.05 |
| | LR | 0.789 | 28.794 | 0.000 | Significant | | | | - |
| Source: Computed by the I | Researcher's | (2022) | | | | | | | |

*Dependent Variable=PF

From Table 4.5, Linear Regression (LR) exerted positive and significant influence on SVPF (p<0.05). It indicated that a percentage increase in LR resulted to 78.9% increase in PF. The constant value showed that PF was 107.0% as RSP was zero and significant (p<0.05). The LR was in compliance with the *apriori* expectation stated by the researcher of the present study. R, which is the correlation coefficient, indicated that the relationship between LR and PF was 86.0%. R² (coefficient of determination) showed that 74.0% variation in the PF was attributed to the influence of LR and Adjusted R² indicated that exact 73.9% changes in the PF could be explained by the influence of LR in the model. The F-ratio (829.117, p<0.05) calculated indicated that both R^2 and Adjusted R^2 were significant in the model. The null hypothesis, which states that linear regression does not significantly influence performance of SMEs in Uyo metropolis, was rejected and the alternative hypothesis, which states that linear regression significantly influence performance of SMEs in Uyo metropolis, was accepted because both t-statistics and the p-value showed that LR was significant.

Hypothesis Two

The simple linear regression statistics were computed and presented on the Table 4.6:

| TABLE 4.6: Simple Linear Regression Output | | | | | | | | | | |
|--|----------|---------|----------------|-------------|-------|----------------|--------------------|-----------------|--|--|
| Variable | Beta (β) | t-Stat. | P-Value | Remark | R | \mathbb{R}^2 | Adj R ² | F-ratio | | |
| Constant | 1.841 | 14.172 | 0.000 | Significant | 0.794 | 0.630 | 0.629 | 496.318, p<0.05 | | |
| LR | 0.629 | 22.278 | 0.000 | Significant | | | | - | | |
| | | | | | | | | | | |

Source: Computed by the Researcher's (2022)

*Dependent Variable=PF

From Table 4.6, Linear Programming (LP) had a positive and significant influence on PF (p<0.05). It indicated that a percentage increase in LP resulted to 62.9% increase in PF. The constant value showed that PF was 184.1% as LP was zero and significant (p<0.05). The LP was in compliance with the *apriori* expectation stated by the researcher of the present study. R, which is the correlation coefficient, indicated that the relationship between LP and PF was 79.4%. R² (coefficient of determination) showed that 63.0% variation in the PF was attributed to the influence of LP and Adjusted R² indicated that exact 62.9% changes in the PF could be explained by the influence of LP in the model. The F-ratio (496.318, p<0.05) calculated indicated that both R^2 and Adjusted R^2 were significant in the model. The null hypothesis, which states that linear programming does not significantly influence performance of SMEs in Uyo metropolis, was rejected and the alternative hypothesis, which states that linear programming significantly influence performance of SMEs in Uyo metropolis, was accepted because both t-statistics and the pvalue showed that LP was significant.

Hypothesis Three

The multiple linear regression statistics were computed and presented on the Table 4.7:

| TABLE 4.7: Multiple Linear Regression Output | | | | | | | | | |
|--|-------------|-------------------|---------|---------|-------------|-------|----------------|--------------------|-----------------|
| | Variable | Beta (β) | t-Stat. | P-Value | Remark | R | R ² | Adj R ² | F-ratio |
| | Constant | 1.135 | 8.387 | 0.000 | Significant | 0.869 | 0.755 | 0.751 | 221.281, p<0.05 |
| | LR | 1.029 | 11.703 | 0.000 | Significant | | | | |
| | LP | 0.566 | 4.034 | 0.000 | Significant | | | | |
| | Decearaber' | (2022) | | | | | | | |

Source: Computed by the Researcher's (2022)

*Dependent Variable=PF



From Table 4.7, LR and LP had significant influence on PF (p < 0.05). It indicated that a percentage increase in all the predictors (LR and LP) resulted to increase in PF. The constant value showed that PF was 113.5% as LR and LP were zero and significant (p<0.05). R, which is the correlation coefficient, indicated that the relationship between LR, LP and PF was 86.9%. R² (coefficient of determination) showed that 75.5% variation in the PF was attributed to the influence of LR and LP and Adjusted R² indicated that exact 75.1 % changes in the PF could be explained by the influence of LR and LP in the model. The F-ratio (221.281, p<0.05) calculated indicated that both R^2 and Adjusted R^2 were significant in the model. The null hypothesis, which states that linear regression and linear programming have no combined influence on performance of SMEs in Uvo metropolis, was rejected and the alternative hypothesis, which states that linear regression and linear programming have combined influence on performance of SMEs in Uyo metropolis, was accepted because R2 and F-ratio (221.281, p<0.05) was significant.

4.2 Discussion of the Findings

From Tables 4.5, 4.6 and 4.7 Linear Regression (LR) had a positive and significant influence on Performance (PF) of SMEs in Uyo metropolis. The outcome of the analysis was in compliance with the *apriori* expectation stated by the researcher. This indicated that a percentage increase in LR resulted to increase in PF of SMEs in Uyo metropolis. When linear regression is applied appropriately in forecasting of activities of SMEs, performance of the enterprises could be improved significantly. Linear Programming (LP) had a positive and significant influence on Performance (PF) of SMEs in Uyo metropolis. The outcome of the analysis was in compliance with the *apriori* expectation stated by the researcher. Also, when linear programming is adopted in assessing the optimality of actions in the enterprises.

All the variables of quantitative measures (LR and LP) had a significant influence on Performance (PF) of SMEs in Uyo metropolis. This was determined by the level of significant of R2=75.5% and Adjusted R²=75.1% (F-statistics=221.281, p<0.05). This indicated that quantitative measures application could guarantee the performance of SMEs in Uyo metropolis. For quantitative measures to affect performance of an organization, all the variables must be effectively managed and the aim of such planning must be stated vividly. The results of this study was in line with Devi and Devaki (2019) who applications of quantitative techniques in decision making of business organisation.

V. SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of the Findings

The study was conducted to examine the influence of quantitative measures application on performance of SMEs in Nigeria by taking Uyo metropolis, Akwa Thom State as a study area. The essential variables of quantitative measures used in this study were Linear Regression (ER) and Linear Programming (LP). These were drawn from the specific objectives of the study. The dependent variable was Performance (PF) of SMEs in Uyo metropolis. Relevant data in relation to the variables of this study were collected from the opinion of the respondents sampled for this study. Cross-sectional data were collected with the use of structured questionnaire. The essential data collected were analysed with the help of statistical tools known as descriptive statistics, linear regression model, with the inclusion of correlation coefficient, R-Square, Adjusted R-Square, t-Statistic, F-ratio and P-value. All regression analyses were carried out at 5% level of significance.

The following below were the summary of the study from the analyses:

- i. LR indicated a positive and significant influence on PF (P-value<0.05).
- ii. LP showed a positive and significant influence on PF (P-value<0.05).
- iii. ER and LP had combined and significant influence on PF because $R^2=75.5\%$ and Adjusted $R^2=75.1\%$ (F-statistics=22 1.281, p<0.05).

5.2 Conclusion

The study was carried out to examine the influence of quantitative measures application on performance of SMEs in Uyo metropolis, Akwa Ibom State. The essential variables for quantitative measures used in this study were Linear Regression (LR) and Linear Programming

(LP). The dependent variable was Performance (PF) of SMEs in Uyo metropolis. From the analyses of the sourced data, it was concluded that quantitative measures application had positive and significant influence on performance of SMEs in Nigeria.

5.3 Recommendations

The following recommendations were suggested from the empirical results of the study by the researcher:

- i. Linear regression should be appropriately applied in the operations of SMEs in Nigeria for the purpose of solving decision problems and improve upon performance of the enterprises.
- ii. Linear programming measure should be adopted accordingly in the operations of SMEs in Nigeria to enable managers to appropriately estimate the optimal activities to embark on to raise performance.
- iii. quantitative measures should be applied in SMEs for the purpose of raising the performance indicators of the enterprises.

5.4 Suggestions for Further Studies

From the findings of this study, other areas that were not covered in the present study were suggested for further studies as stated below:

- i. Quantitative measures application and performance of Small and Medium Scale Enterprises (SMEs) in Nigeria should be investigated by other researcher(s) by including other quantitative measures.
- ii. Quantitative measures application and performance of manufacturing companies in Nigeria should be researched further.



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