THE RELEVANCE OF SENSITIVITY ANALYSIS IN THE INVESTMENT DECISIONS OF PORT HARCOURT INVESTMENT HOUSES: AN EMPIRICAL INVESTIGATION

NDU, EUGENE C.
Department of Hospitality Management and Tourism
Faculty of Management Sciences
University of Port Harcourt
Email: reformation2021@gmail.com, eugene.ndu@uniport.edu.ng
Tel: +2348033368600

And

ANYANWU, SUCCESS A. C., PhD.
Department of Management
Faculty of Management Sciences
University of Port Harcourt
Email: marizu1958@yahoo.com
Phone: +2348037079138

Abstract

This paper investigated the relevance of sensitivity analysis (SA) in investment decisions (IDs). Its purpose was to identify the relevance (if any) of SA in IDs. Two research questions guided the study: "Is SA relevant in IDs"? And "What is the relevance of SA in IDs"? The study sample comprised twenty-six managers of thirteen investment houses in Port Harcourt; drawn through the judgmental sampling technique. The study adopted mean and standard deviation techniques to answer the research questions. The result showed that SA is relevant in IDs. The relevance stems from the fact that among other things, it helps the ID maker know the influence that variations in a specific parameter will have on proposed IDs; as well as help the ID maker to ascertain which parameters are the significant drivers of the ID model's results. Based on these, it was concluded that SA is very important in IDs; and should be utilized to improve on the quality of IDs. It was recommended among other things that ID makers should always develop SA models to further analyses their IDs; and the outcome of such modeling should be used to make informed decisions.

KEYWORDS: Business Environment, Internal Rate of Return (IRR), Net Present Value (NPV), Pay Back Period (PPB), Risk and Uncertainties.

Introduction

Decision making which has come to be recognized as the most imperative task of a manager, is often a very grim one. The use of intuition, rules of thumb, tradition, and simple financial analysis are often no longer adequate for addressing such common decisions as make or buy, facility site choice, and process redesign. There is a need for an improved decision making at all levels in organizations due to the intense forces of competition and the dynamic

nature of business environment. In view of this, the need for more effective investment decision making need not be overemphasized. An appreciation of the importance of investment decisions (**IDs**) and the possible consequences of making ineffective **IDs** underscores it. It is believed that the bulk of managerial challenges facing organizations, including managing investments as well as investment decision making, are lived through under uncertainty (Sequire & Tak cited in Jovanovich, 1999). This uncertainty makes it difficult to predict events with a great degree of accuracy.

This impracticality in foretelling probable future events perfectly enough, and concrete values required for precise preparation of decisions, affect investment decision-making to a great extent; reducing likelihoods of choice. However, improved acquaintance with decision-making process under the condition of uncertainty, and of decision-making criteria accessible by theory as well, certainly exert influence by enhancing choices and by reducing the likelihood of decision-making (Jovanovich). Clarifications of problems relating to investment decision making under the condition of uncertainty, particularly appraisal of investment projects in circumstances of risk and uncertainty, are likely to implement diverse procedures and techniques. Some of the best identified approaches adopted in making investment decision as stated by Jovanovich are: Theory of Games, Break-even Analysis, Scenario Method, Sensitivity Analysis, and Decision Making Theory etc. Amongst these, sensitivity analysis appears to be striking in that; it is a method for defining how much a projected payoff will vary in reaction to a certain alteration in an input variable (all other factors remaining constant).

The attractiveness of sensitivity analysis (**SA**) stems from its uses. Research shows that though it may be applied to a wide range of subjects such as business, chemical kinetics (Rabitz, Cramer & Dacol, 1983; Turanyi, 1990), environmental forecasts, meta-analysis etc.; its uses are relatively general and include: To streamline models, to examine the strength of the model forecasts, To show what-if analysis exploring the influence of erratic input expectations and circumstances, as a component of quality assurance (unforeseen elements sensitivities may be connected to coding imprecisions or misspecifications). It also provides information on issues that frequently come to play in the output variability and interaction between factors. Different factors have been found to influence or impact on **IDs** (Shih & Trappey, 2008; Savvides, 1994; Squire & Tak, 1979; Jovannic, 1999); amongst which is **SA**. The interest of this paper however, is to investigate and identify the importance or benefits (if any) of **SA** on **IDs**.

Over the years, the problem of failed investments has been a recurring decimal. In some cases, financial institutions and investment houses that should have known better are even involved. When such failures occur, investors, families and affected organizations are often destabilized. In some cases litigations are inevitable; while in extreme cases, suicide and murder attempts are not far-fetched. The famous 'Umana – Umana Bank' which held sway in Port Harcourt in the late 90s and early 2000s with its attendant consequences when it was clamped down upon by the then Rivers State government is still fresh in mind. Needless to say what the fate of many would be when the numerous Ponzi schemes now in vogue fail. The problem is that most investors are either uninformed or chose be ignorant while hoping that investments yield returns as expected. Reality is that most times, such expectations are not met; yet they and prospective investors have failed to learn their lessons. Though **IDs** may be affected by

different factors; depending on the level of uncertainty and risk involved; the basic criteria for **IDs** include Net Present Value (NPV), Internal Rate of Return (IRR) and Payback Period (PBP). Although **SA** may serve as a tool for decision making, its adoption in **ID** making especially in the situations of uncertainty comprises numerous crucial input considerations. Some of which include the associated costs, accruable incomes, worth of investments, discount rate, consequences of failure etc. It equally includes the thought of implications and influence of variations of these factors on the values of the decision criterion.

The focus of this study is not the examination of the effect of these input parameters of **SA** on any **ID** criterion. Rather, it bothers on the identification of the importance of **SA** in **IDs** irrespective of the criteria. This study therefore had two main purposes. The first was to determine if **SA** is of any relevance in IDs. The Second was to identify and present a listing of the possible importance of **SA** in **IDs** if the first purpose holds true. To this end, two research questions were asked and answered.

Research Question 1: Is sensitivity analysis relevant in investment decisions?
Research Question 2: What is the relevance of sensitivity of analysis in investment decisions?

It is expected that the outcome of this study will be of immense benefit to **ID** makers who will use it to enhance the quality and robustness of their decisions. Financial analysts will use it as basis for interpreting **IDs**. Government and regulatory agencies will find it as a veritable tool for policy formulation and regulation. While the academia will use it to further the course of research and increase the repertoire of knowledge on the subject matter. The content scope of this study was limited to literature on **SA** and **IDs**. Geographically, the study was limited to investment houses in Port Harcourt city. While the unit of analysis was managers of the sampled investment houses; thereby making it a macro level study. In spite of the relative small sample size used for the study (26 managers) which may have limited the findings; the study outcome can be inferred upon a wider geographic scope.

Literature Review

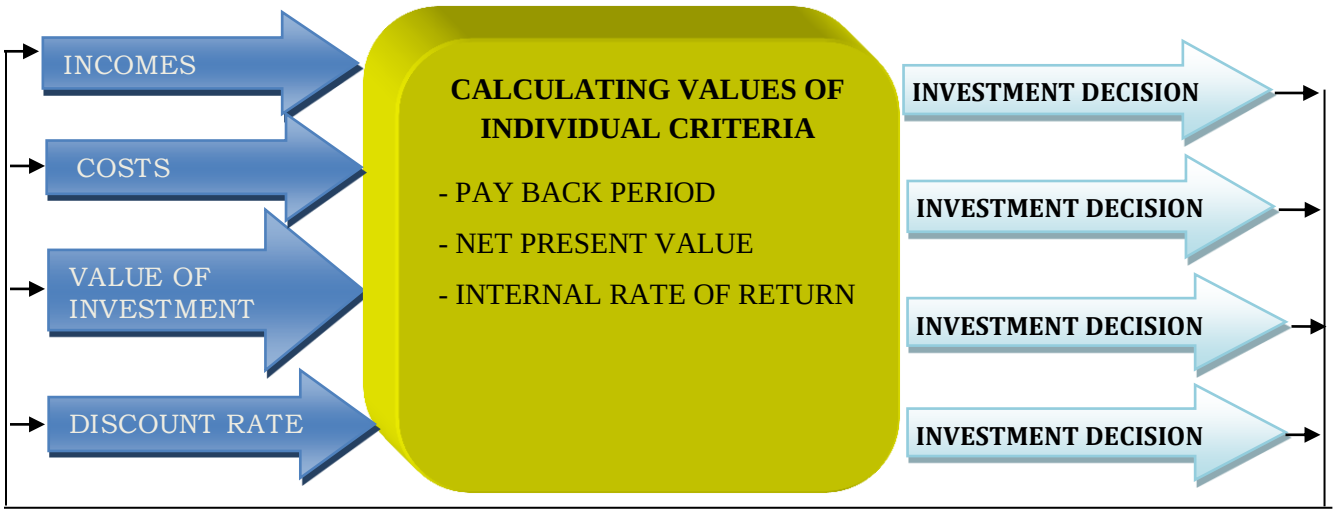
Theoretical Framework

The baseline theory used for this study is the 'Agency Theory'. It explains the huddles associated with investors (principal) and management (agents). It is generally accepted that the central goal of every business is to maximize owners' wealth. This can only be accomplished when investment decisions are effectively and efficiently made. Brophy and Shulman (1993) asserted that the challenges of agency arise when the principal request the service of someone else to perform certain task on their behalf. Agency Theory postulates that the principals who are the owners of firm seek to maximize profit and the value of the firm; while the managers who are the agents pursue strategies which will secure their employment and increase their compensation. Taylor, Jordan and Lowe (1999) opined that managers may as a result of this embark on investment decisions that may not be profitable to the owner but which will foster their personal interest; and this may be difficult to detect due to the asymmetric nature of information. Applying the **agency theory** to this study describes the relationship that exists between investment houses and their customers (investors).

An investment house can be likened to an agent whose primary goal is to maximize the wealth of its clients, which are the investors. This they can accomplish by making the right **IDs** on behalf of these investors. Making such **IDs** is not an easy task; therefore the investment houses must endeavor to critically analyses all the possible input factors that can influence the outcome of their decisions. There is therefore need for them to carry out **SA** on all possible input elements in order avoid making **IDs** that may not be of any significant benefit to the investor. If investment houses truly stand for what they purport, which is to maximize the wealth of investors, there is need for them to carry out adequate analysis before making any **ID**. Hence, there is need for **SA** to be used as a tool for making quality **IDs** that maximize shareholders' wealth and reduce the usual friction that characterize principal–agent relationships.

Conceptual Framework

Fig 1: Conceptual Framework of Sensitivity Analysis and Investment Decisions



Source: Researchers' Conceptualization, 2014

The researchers came up with figure 1 above as a model of the perceived relationships between **SA** and **IDs** after reviewing the related literature. From the figure above, it could be seen that any of the input values which are the sensitivity factors (incomes, costs, value of investment, discount rate, etc.) can be introduced into the decision criteria values, which may be PBP, NPV or IRR; and the outcome in form of the observed variation noted for further investment decision. It should also be seen that each of the outcomes can inform fresh inputs or lead to a variation of the sensitivity factors for further processing and outcome. This framework simply portrays sensitivity analysis as a typical systemic model.

The Concept of Sensitivity Analysis (SA)

Sensitivity analysis according to investopedia (2011) is a method adopted to measure how diverse values of an autonomous variable will influence a specific dependent variable within a particular list of expectations. It is adopted within definite boundaries that will rely on

single or more input variables, such as the impact of variations in interest rate on the price of a bond. Hence, **SA** is simply an approach to calculating the result of a decision if a condition should be altered in comparison with the main expectation(s).

Sensitivity analysis is an important tool in measuring the effect an actual result of a certain variable will have if it is eventually different from the initial assumption. The analyst can therefore ascertain how the variation in one variable(s) influences the target variable, by forming a specified set of circumstances. For instance, an expert might construct a financial model that will estimate the equity of company with respect to stated value of earnings per share at the financial year end and the company's price-to-earnings multiple at that time. The analyst can build a table of estimated price-to-earnings multiples and a resultant value of the company's equity centered on diverse values for all the autonomous variables.

Uses and Application of Sensitivity Analysis

SA can be used in a varied number of ways and in different fields. However, on a general note, Wikipedia (2011) opined that it can be useful in the following ways: – to streamline simulations, estimate the magnitude of the model calculations, show 'what-if' analysis by examining the effect of changing input assumptions and circumstances; as well as serve as a factor of quality assurance. **SA** is commonly used in physics and chemistry (Saltelli, Ratto, Tarantola and Campolongo, 2005). It can be used in any area where models can be developed ranging from financial applications, signal processing, and risk analysis, neural networks etc. **SA** can as well be adopted in model-based policy assessment studies and in assessing the magnitude of composite indicators (Saisana, Saltelli and Tarantola, 2005). **SA** is a veritable tool in business decisions. For instance, in a situation of making decisions, the expert may wish to ascertain cost drivers and other measures for which there is a need to attain a clearer view in order to make a sensible decision. From another perspective, some factors possess little or no effect on expectations, these scenarios can be ignored to save resources without any reduction in accuracy. **SA** can be useful in several other situations such as: to ascertain vital assumptions or compare diverse model constructs; monitor the collection of data in the future, discover essential measures, improve the acceptance of produced parts in respect to the level of uncertainty in the considerations, improve the allocation of scarce resources and as well as to simplify models.

Errors in Sensitivity Analysis

The usefulness of **SA**, has led to some errors in its usage; such as Types I, II and III errors. According to Wikipedia (2011), Type I error occurs when a non-important factor is considered as important, while Type II error; occurs when an important factor is regarded as non-important. Type III error is related to examining the mistaken problem, e.g. through a wrong description of the input uncertainties. Wikipedia has outlined likely drawbacks of sensitivity analysis to comprise:

1. Blurred aim of the investigation. Diverse statistical tools are used on the problem and several elements rankings are attained. The investigation should be rather geared towards a more specific purpose of the analysis, e.g. analyst use Monte Carlo filtering when concerned elements which are most answerable for creating high/low values of the output.

2. It considers several outputs which are regarded as too much for the overall analysis. Though these outputs can be satisfactory for quality assurance sub-models but ought to be ignored once dealing with general investigation.
3. Piecewise sensitivity: This simply means carrying out sensitivity analysis on a single sub-model at a point in time. **SA** may lead to type II error due to its non-conservative methodology which may ignore the interactions among elements of diverse sub-models.

In addition to these pitfalls, some difficulties connected with sensitivity analysis in business situation are:

1. Variables are mostly interrelated, such that change in one will affect other variables; therefore inspecting them separately may be impractical. For instance, a change in one element such as volume of sales may likely influence other factors like selling price.
2. The underlining assumptions are mostly based on past data and experiences, which may not be totally relevant with future realities.
3. The technique is subjective in nature such that allocating a maximum and minimum value (or hopeful and doubtful) is vulnerable to personal experiences and perception of the analyst. For example one individuals' 'optimistic' prediction may be more conservative than that of someone else carrying out a diverse aspect of the analysis. This subjective nature can truncate the correctness and overall objectivity of the investigation.

The Concept of Investment Decisions (IDs)

It is important to explain here the basic assumptions and conditions under which **IDs** are made, before delving into full explanation of the meaning of the concept. Literature on investment decisions reveal that it is usually classified based on the degree of knowledge about the future. Hence, three categories have been identified: decision making under the conditions of **uncertainty**, **risk** and **certainty**. According to Jovanovich (1999, p. 218), investment decision-making involving the conditions of uncertainty is the decision-making which involves diverse predictions of different values or criteria for each investment substitute; and where alternative which will be realized in practice are unknown.

He posited further that the making of **ID** in situation of risk involves numerous predictions of diverse values of measures for each investment options, but with an identified likelihood of their occurrence. Investment decision-making under situation of certainty is the type where all substitute usually provides one and equal criterion value, i.e., where it is possible for us to foretell all required future values with absolute correctness. The implication here is that **ID** makers under conditions of uncertainty are of the optimistic school; while **ID** makers under conditions of certainty are of the pessimistic school. However, **ID** makers under conditions of risk irrespective of the extent of risk involved are considered to be rationalistic in approach i.e. rational school. While the views of each of these schools of thought are respected, the approach adopted for this study, is the optimistic school; in which case investment decision is made under conditions of uncertainty. This approach is predicated on the volatility and complexities that characterize the business world; hence the need for **SA.** Some of the proponents of this approach are Jovanovich (1999); Shih and Trappey (2008).

Management need to apportion scarce resources amongst contending prospects (projects) in a method referred to as capital budgeting (Harvey, 1997; Chance, n.d). The process of making capital allocation or **IDs** involve estimating the value of each project, which may be in terms of the scope, timing and probability of prospective cash flows (Wikipedia, 2011). It is this selection of an opportunity or project in preference to another, based on the expected returns or benefits that are referred to as **ID**. These decisions may be long-term or short-term in nature. A long-term investment decision is known as capital investment decision (CID). A short-term investment decision is known as working capital management. Damodaran (cited in Wikipedia, 2011) opined that CIDs as long-term corporate financial choices are usually associated with fixed assets and capital structure. He further stated that these decisions are established on different inter-related benchmarks. Viz:

1) Management pursues to enhance the firm's worth by making appropriate investment on viable projects which may produce a favorable net present value when estimated by a suitable discount rate in respect to the risk level.
2) These opportunities need to be financed in the most effective and efficient manner.
3) Where there are no investment opportunities available, to maximize shareholders' wealth, management needs to return excess cash to shareholders (distributed as dividends).

Capital investment decisions therefore include an investment decision, a financing decision, and a dividend decision. According to Wikipedia (2011), investment decisions usually involve three processes - project valuation, valuing flexibility and quantification of risks. These have been discussed in detail.

Project valuation

Generally, in estimating the value of a project, the discounted cash flow technique (DCF) is usually adopted and any project which promises a greater yield as estimated by the adopted net present value (NPV) will be nominated (Damodaran, n.d; Harvey, 1997). This entails valuing the cash flows accruable from each project. Such prospective cash flows are then discounted to ascertain their present value. These present values are then summed, and this sum net of the initial investment outlay is the NPV. The discount rate largely affects the NPV. Thus, ascertaining the appropriate discount rate - often referred to as the project "hurdle rate" is vital to making the right decision. The hurdle rate according to investopedia, is the least return acceptable on an investment—i.e. the perceived appropriate discount rate of the project. It is expected to reveal the risk level of the investment, which is usually measured by volatility of cash flows, and must take into consideration the financing mix. There are quite a lot of other methods used as selection criteria in corporate finance. These are evident from the DCF and consist of discounted payback period, IRR, Modified IRR, capital efficiency, equivalent annuity, and return on investment.

Valuing Flexibility

A strict NPV technique may not fully capture a project which opens or closes the path of action to an enterprise, particularly R&D projects (Arnold & Shockly, 2002). In these scenarios, there is need for management to occasionally select the right tools which will place clear values

on these opportunities. Meanwhile the probable or average cash flows are discounted in a typical DCF technique. In this case, the “flexible and staged nature” of the investment is modeled, and hence "the entire" prospective payoffs are put into consideration. What differentiates these two techniques is the level of flexibility associated with the project. Decision Tree Analysis (DTA) and Real Options Analysis (ROA) are the most common tools and are often used interchangeably.

Quantifying Uncertainty

Considering the degree of uncertainty associated with project estimation and valuation, experts will desire to evaluate the sensitivity of project NPV to a number of inputs (i.e. assumptions) to the DCF model. In a real sensitivity analysis the forecaster will change one significant element, while other factor inputs are made to be unchanged, ceteris paribus. The sensitivity of NPV to a variation in such element will afterward be evaluated, and will be estimated as a "slope": ΔNPV / Factor. For example, the forecaster will ascertain NPV at different growth rates in yearly incomes as stated (mostly in series of e.g. -10%, -5%, 0%, 5%..`), and then calculate the sensitivity, going by this method. In most cases, a number of variables might be more significant, and combining them may result in a "value-surface" (or "value-space"), where NPV is then a function of different variables. Other associated techniques analysts use in quantifying uncertainty include scenario based forecasts of NPV, stochastic or probabilistic financial models such as Monte Carlo simulation method.

Application of Sensitivity Analysis in Investment Decisions

It was established earlier that most management decisions are made and lived through under conditions of uncertainty. Thus since **IDs** try to make projection for future expected benefits, they can only be made under conditions of uncertainty or risk. For the purpose of this work, only the condition of uncertainty is considered. Some of the input parameters as shown in the conceptual model include cost, income, investment value and discount rate. The usual practice is to vary the value of these input parameters and observe the effect they will have on the **ID** making criteria (say NPV, IRR or Payback Period). Recall the meaning of these decision criteria:

NPV (Net Present Value): This is the sum of the present values of all the cash flows associated with the project (Telsang, 2013, p. 489); in this case, investment project. According to Gupta and Hira (2013, p. 885), the equation for NPV assuming that all cash outflows are made in the initial year t_0 can be given as:

$$NPV = [A_1/ (1+k)^1 + A_2/ (1+k)^2 + \cdots + A_n/ (1+k)^{n]} - C$$

$$= \sum_{i=1}^{n} [A_1/ (1+k)^1] - C$$

Where:

A_1, A_2, A_3, A_n = Cash Inflows

k = Cost of Capital

C = Initial Cash Outlay

n = Project Life

IRR (Internal Rate of Return): This according to Gupta and Hira (2013, p. 887), is the rate at which the NPV of the investment is zero; and can be determined from the equation below:

$$C = [A_1/(1+r)^1 + A_2/(1+r)^2 + \cdots + A_n/(1+r)^n] = \sum_{i=1}^{n} [A_1/(1+r)^1]$$

Or $$\sum_{i=1}^{n} [A_1/(1+r)^1] - C = 0$$

Where:

A_1, A_2, A_3, A_n = Cash Inflows

r = Interest rate

C = Initial Cash Outlay

n = Project Life

PBP (Pay Back Period): According to Telsang (2013, p. 489), it is the number of years required to recover the total amount invested in a project; and is mathematically it is given as:

$n = I/B$ (When the cash flows are the same in each year)

Where:

n = Payback period in years

I = the initial investment.

B = the net returns per annum

Or

$n = I / [\sum_{i=1}^{n} (R_i - D_i)]$ when the cash flows are not the same each year.

Where:

R_i = Income during the period i (i = 1, 2, 3, n)

Di = Operating expenses during period i.

I = the initial investment.

Having refreshed our memories on these decision criteria variables, it is pertinent at this juncture that we see an example of how **SA** can be carried out on investment **IDs**. The steps involved are as follows:

Step I: Define the quantitative criteria for evaluating the investment.

Step II: Define the input values of the calculating criteria.

Step III: Choose the input parameters whose effect on the output will be analyzed. For example, one could choose to analyses the effect of variation on the projects investment income (denoted by **A**), the projects investment value (denoted by **C**) and the cost of capital (denoted by **r**).

Step IV: Specify the movement interval of these values (C_{m-1} to C_{m+1}), that can be used to calculate the values of the individual criteria.

Step V: Calculate individual value criteria so as to ascertain the values of some input variables for the determination of the upper and lower values that some of the model's variables can take for the investment to still be viable. These results are usually presented in a table.

Step VI: Analyze and interpret these results as well as specify measures to be taken to avert or mitigate adverse effects.

Obviously, there are other ways to conduct **SA** depending on the purpose, conditions and influencing factors. However, a systematic computation of **SA** especially in **IDs** require complex and tedious calculations because, the input values and number of criteria to be considered are usually large. This makes the use of computer in such calculations inevitable. It should be noted that the software packages that can be used for such computations are available.

An Example of SA Computation

A specific example of how to apply **SA** in **IDs** has been attempted below under the conditions of uncertainty. The input parameters considered for this example are investment income (A), investment value (C) and costs of investment project (B). Based on this, we can represent net income (NA) as follows:

NA = A – B – C.

It is clear from this equation that factors like investment incomes, cost of investment project, cost of capital, as well as the project's gestation period exert the most influence on NPV, IRR and PBP. They are as well the values used for computing these **ID** criteria; and analysts are required to predict these variables. In real life, these input parameters can change or fluctuate due to environmental factors. The duty of the analyst is to foresee and vary the values of these input parameters and note the impact such variations may have on the decision criteria. To accommodate this in the model, coefficients of adjustment are introduced into the formula as follows:

NA = (A**.**a) – (B**.**m) – (C**.**c)

Where:

a = adjustment factor for investment income.

m = adjustment factor for project investment cost

c = adjustment factor for investment value

Also to be considered in the model is the coefficient of adjustment for cost of capital (d). The resulting NPV or IRR or PBP as a result of this formula will be a function of these adjustment factors. The table below shows what the outlook would look like if we base the computations only on one decision criteria, say NPV.

Table 1: Sensitivity Analysis on Investment Decision Criteria – NPV

	c_o = 1.10	c_1 = 1.10	c_2 = 1.20	c_3 = 1.30	….	c_n
d_o	NPV_{00}	NPV_{01}	NPV_{02}	NPV_{03}	….	NPV_{0n}
d_1	NPV_{10}	NPV_{11}	NPV_{12}	NPV_{03}	….	NPV_{1n}
d_2	NPV_{20}	NPV_{21}	NPV_{22}	NPV_{23}	….	NPV_{2n}
d_3	NPV_{30}	NPV_{31}	NPV_{32}	NPV_{33}	….	NPV_{3n}
.	.	.	.	.	.	.
.	.	.	.	.	.	.
d_m	NPV_{m0}	NPV_{m1}	NPV_{m2}	NPV_{m3}	.	NPV_{mn}

(a = constant; m = constant)

Table1 above shows a typical computation of **SA** in an **ID** using NPV as the only criteria. Here, the combined effect of capital cost variation (d) and investment value variation (c) on the decision criteria (NPV) is tested while holding investment income and investment cost variations constant. From the table, it could be seen that at capital cost d_1, a variation of 10% and 20% can be accommodated; in which case, investment value adjustment $c_1 = 1.10$, and $c_2 = 1.20$. But for the same capital cost value, a 30% adjustment ($c_3 = 1.30$) cannot be accommodated because it falls below the accommodation line (the non-shaded region). This is a simplistic model. In reality, it is possible to conduct **SA** using several input parameters at the same time. This will produce a lot of information that can be used to reduce the effect of uncertainties in the environment, and improve on the quality of **IDs** made under conditions of uncertainty.

Methodology

The study adopted a descriptive survey method for the research design. In using this method, the observations in the study sample were analyzed and the result used to make inference upon the study population. Since the study is interested in investment decisions, the sample units are the investment houses in Port Harcourt, Rivers state. Consequently, the target population comprised the managers of all the thirteen registered investment houses within the Port Harcourt city (Infoisinfo, 2016). Purposively, two managers were chosen from each investment house; giving rise to a sample size of twenty-six. Data for the study was collected primarily through a questionnaire developed by the researchers. The questionnaire was titled 'The Relevance of Sensitivity Analysis in Investment Decisions'. Its purpose was to elicit information on the perceived relevance of sensitivity analysis in investment decisions from the respondents; who ideally are used to the application of **SA** in **IDs**. To validate the instrument, copies were given to professionals in the field; to enable them make necessary corrections and inputs. These contributions were revised and incorporated into the final copy; which helped to guarantee both the face and content validities of the instrument. The instrument's reliability was guaranteed using the test - retest method; and the correlated results showed a stability level of 0.78. The variables of the study are sensitivity analysis, which is the independent variable and investment decision which is the dependent variable. **SA** was operationalized by asking the question 'To what extent do you find sensitivity analysis useful in your investment decisions'? The response format which was based on a five point Likert-like scale is as follows: Very High Extent (VHE) – 5; High Extent (HE) - 4; Moderate Extent (ME) – 3; Low Extent (LE) – 2; and Very Low Extent (VLE) – 1. **ID** was operationalized by asking two questions:

1) To what extent do you consider the following as benefits which you derive from using sensitivity analysis in enhancing your investment decisions? The response format for each of the options was also based on a five point scale as stated above.
   a. It helps me to know the influence that variations in a particular parameter will have on projected investment decisions.
   b. It helps me to determine which parameters are the key drivers of my model's results.
   c. It increases my level of confidence in the model used for investment decisions.
   d. It enhances the quality of my investment decisions.

e. It puts me in a better position to manage the uncertainties and complexities that characterize the business environment.

2) Considering the uncertainties associated with investment decision-making, how often would you like to use sensitivity analysis to enhance your decisions'? The response format was as well based on a five point Likert-like scale: Very Often (VO) - 5; Often (O) – 4; Occasionally (Oc) – 3; Once in a while (OW) – 2; and Never (N) – 1.

The mean and standard deviation analysis techniques were used to analyses responses to the research questions.

Results and Discussion

The data generated from the questionnaire were used to analyze and answer the research questions; as well as test the hypothesis. Twenty six copies of the questionnaire were administered; two to each of the investment houses sampled. Out of this number, twenty-two copies were retrieved; while two copies out of the responded questionnaire were found to be unsuitable for the analysis. Consequently, only twenty copies were used for the analysis questionnaires were responded and returned, and found to be valid for the analysis; giving rise to a 76.92% response rate. The responses have been summarized in the tables below for the requisite analysis. For the purpose of this study, 'Very Large Extent', 'Large Extent' and 'Moderate Extent' were grouped as "agree", while 'Low Extent' and 'Very Low Extent' were grouped as "disagree".

Table 1: Usefulness of Sensitivity analysis in Investment Decisions

S/N	QUESTION	VLE (5)	LE (4)	ME (3)	LE (2)	VLE (1)	Score	No.of Resp	Mean	Cut- off Point	Std. Dev	Remark
1.	To what extent do you find sensitivity analysis useful in your investment decisions?	10	6	4	-	-	86	20	4.3	3.00	0.78	Acepted

Source: Survey Data, 2014

The table above shows a mean score of 4.3 as against the cut-off point of 3.00 and a standard deviation of 0.78. Therefor it was accepted that sensitivity analysis is relevant in investment decisions.

Research Question 2

What is the relevance of sensitivity of analysis in investment decisions?

This research question was answered with responses to question 2 of the questionnaire (To what extent do you consider the following as benefits which you derive from using sensitivity analysis in enhancing your investment decisions) as shown in table 2 below. The analysis was carried out via mean and standard deviation technique.

Table 2: Relevance Role of Sensitivity Analysis

S/N	Possible Relevance	VLE (5)	LE (4)	ME (3)	LE (2)	VLE (1)	Score	No.of Resp	Mean	Cut- off Point	Std. Dev	Remark
i	It helps me to know the impact that changes in a certain parameter will have on proposed investment decisions	14	4	2	-	-	92	20	4.60	3.00	0.66	Acepted
ii	It helps me to determine which parameters are the key drivers of my model's results.	12	6	2	-	-	90	20	4.50	3.00	0.67	Acepted
iii	It increases my level of confidence in the model used for investment decisions.	8	6	4	2	-	80	20	4.00	3.00	0.78	Acepted
iv	It enhances the quality of my investment decisions.	6	10	4	-	-	82	20	4.10	3.00	0.70	Acepted
v	It puts me in a better position to manage the uncertainties and complexities that characterize the business environment.	8	6	2	4	-	78	20`	3.90	3.00	1.14	Acepted

Source: Survey Data, 2015

Table 2 reveals that the mean cut-off point is 3.00. Hence items with mean of 3.00 and above were accepted as applicable. These are: It helps me to know the influence that changes in a certain parameter will have on proposed investment decisions. (4.60); It helps me to determine which parameters are the key drivers of my model's results. (4.50); It increases my level of confidence in the model used for investment decisions. (4.00); It enhances the quality of my investment decisions. (4.10); It puts me in a better position to manage the uncertainties and complexities that characterize the business environment. (3.90).

Discussions

Research Question 1

The research finding here, showed that **SA** is relevant in **IDs**. This finding is in agreement with the findings of earlier researcher such as Jovanovich (1999). It is quite understandable that investment decisions are not one of those decisions to be made hurriedly or carelessly since it often involves a huge capital outlay. Thus care need to be taken to play the 'what if' scenarios (sensitivity analysis) so as to factor in all possible conditions that may adversely affect the expected outcomes. This study by confirming earlier findings, has reiterated the need for **ID** makers to adopt **SA** as veritable tool for sensible **ID** making. The importance of the finding is also buttressed by the fact that the baseline theory for this study – 'Agency Theory' stressed the need for managers (in this case, investment managers of Port Harcourt investment houses)

To see it as a moral duty to make the best and right **IDs** that maximizes investors' profit (Taylor et al, 1999). They should do this knowing that some of these investors do not possess the knowledge and technical expertise to make such informed decisions for their selves.

Research Question 2

The findings here as outlined in the analysis above, showed a listing of the relevance of **SA** in **IDs** as identified by the sampled mangers. The identified relevance are in agreement with the postulations of Tarantola et al. (2000) and Taylor (2009). These findings have succinctly outlined the importance of **SA** in **IDs** thereby giving a better perspective to decision making. The first, which is that fact that 'it helps the **ID** maker to know the impact that changes in a certain parameter will have on proposed investment decisions' puts the **ID** maker in a better position to forecast and adapt to changes in the environment. It is common knowledge that interest rates, exchange rates, inflation rate, excise duties, tax, monetary / fiscal policies, political climate (Shih & Trappey, 2008) and sundry economic policies are never stable in Nigeria. Hence, **IDs** made without consideration for these fluctuations will most likely affect projected earnings negatively. But with **SA**, the **ID** maker is better prepared to adapt to such changes since he has already considered their possible implication on his projections.

The second relevance which is the fact that 'it helps the **ID** maker to determine which parameters are the key drivers of the **ID** model's results' is supported by the findings of (Jovanovic, 1999; shis & trappey, 2008); and is closely allied to the first relevance. The respondents opined that with **SA** they are able to identify the parameter that is likely to affect their **IDs** most. With this knowledge, such factors are isolated and given a more serious attention. Even if their impacts may not be completely mitigated, a prior knowledge of their likely effect puts the **ID** maker in a better perspective to absorb their undesirable impacts.

The third relevance which is that 'it increases the **ID** maker's level of confidence in the model used for IDs' is quite understandable. Support for this was found in the work of Taylor (2009) who using his work on health economics found that economic modelers can increase their level of confidence in the model used by reporting extensive outputs from sensitivity analysis and considering a wide range of scenarios. Accordingly, investment houses in Port Harcourt can be more confident in their models as they subject them to **SA**. The more confident they are in their decision making models, the more informed decisions they make. Consequently, investors are more likely to trust their judgments and repose more confidence on them.

The fourth relevance which is that 'it enhances the quality of the **ID** maker's investment decisions' is equally expected. Since most **IDs** are made under conditions of uncertainty, the quality of such decisions may be undermined; as such, will not be trusted or relied upon. However, when such decisions are subjected to **SA** the quality seems to improve tremendously and can be relied upon. Taylor (2009) equally was in support of this view when he asserted that probabilistic **SA** is an important method that can be used for quantifying and improving on a decision-maker's confidence level in his economic evaluation conclusions.

The last relevance according to the finding is that it puts the **ID** maker in a better position to manage the uncertainties and complexities that characterize the business

Environment. This can only be expected as **SA** helps the **ID** maker to know the impact of input parameters on the model; identify the parameters that drive change most; as well increase his confidence in the model and improve the quality of his **ID**. How best can an **ID** maker manage the uncertainties and complexities of the business environment other than having these variables properly controlled through **SA**. Moreover, the ethical and moral appeal of the Agency Theory calls for greater care in managing the 'investor – investment manager' relationship. The fact that investment houses in Port Harcourt attested to these points as applicable relevance of **SA** in **IDs** means that this study corroborates earlier findings (Jovanovic, 1990; Shih & Trappey, 2008; Taylor, 2009); thereby making **SA** a veritable tool for effective **ID** making.

Conclusion

This study set out to investigate the relevance of **SA** in **IDs** of Port Harcourt investment houses. To accomplish this purpose, two research questions were asked and answered. First, it was asked if SA is relevant in **IDs**; and second, it was asked 'what is the relevance of **SA** in **IDs'**? To answer these questions, data was generated from twenty managers of thirteen investment houses in Port Harcourt city. These data were analysed using the mean and standard deviation techniques. The result showed that SA is relevant in **IDs**. Its relevance in **IDs** stems from the fact it helps the **ID** maker to know the impact of changes in input parameters on the model; identify the parameters that drive change most; increase his level of confidence in the model; improve the quality of his **IDs** as well as put him in better position to manage the uncertainties and complexities that characterize the business environment. Based on these findings, the researchers conclude that SA is very important in investment decisions and is veritable tool for informed decision making be it investment, strategic, routine or general decision making.

Recommendations

Having x-rayed the relevance of **SA** in **IDs**, viz-a-viz the conclusions drawn from the study, the researchers recommend that:

1. **ID** makers should always endeavor to develop SA models to further analyses their **IDs**. This will help put them in a better position to manage the impact of changes arising from fluctuations in such parameters as exchange rate, interest rate, inflation rate, fiscal / monetary / economic policies, custom / excise duties, and most importantly political instability and interferences.
2. The outcome of such modeling should be used to make informed decisions and be the basis for **IDs**. It should as well be the yard stick for measuring expertise, efficiency and effectiveness of the investment houses.
3. Regulatory agencies should stipulate the use of **SA** in **IDs** as a necessary requirement for investment fund managers and related financial institutions. This will put them in a better position to manage the uncertainties that characterize the business environment. When this achieved, it will help reduce the number of conflicts and litigations arising from such investment related cases.

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