Article

Sustainable Compensation of Damage Accidents Economic Loss of Seaborne Oil and Trade in Nigeria

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Abstract: The study was carried out to develop models for the reservation of funds for sustainable compensation of offshore oil and gas damage accidents economic loss in Nigeria. The objective was to develop models to enable marine underwriters overcome the challenges of financial insolvency in the compensation of insured offshore accident risks, based on the coefficient of elasticity of compensation funds reserved for insured offshore oil and gas risks to the changes in economic consequences of offshore accidents over the years; as well as the coefficients of elasticity of offshore oil and gas accidents economic loss to growth in value of seaborne oil import and export trade between 1999 and 2019. Time series secondary data was used. The Log-log constant elasticity multiple regression models and the ordinary least square multiple regression method were used to analyze the data obtained. Empirical conditions for the reservation of compensation funds for sustainable indemnification of offshore oil and gas accidents economic loss in Nigeria were developed. The policy implications of the findings were discussed.

Keywords: sustainable, compensation, offshore, accidents, economic-loss, Nigeria

1. Introduction

The history of marine navigation, exploration for and exploitation of marine resources provides evidence that; the sea has always been synonymous with uncertainty, absence of safety, and insecurity for those who venture into it [1]. This endemic absence of safety probably explains why early offshore operations, seaborne trade and navigation remained the preserve of adventurers. The sea was associated with the idea of uncertainty, chance or fate,

leading to concepts and expressions such as "marine perils" or "perils of the sea", which is still widely used today in expressing the absence of safety in maritime operations [1]. Maritime operations and seaborne trade evolved in such a laissez – faire manner that, the many accidents of which navigators, offshore workers and seamen were victims were soon accepted, as part of the natural course of things. Reference [2], noted that, the frailty of the human factor, in the face of the inexhaustible and indefinable sea, confers on the effort of maritime operations, navigation and seafaring, the character of a bold venture, which may succeed and prove quite profitable, but which can also fail and cause irreparable losses. Like the Greek proverb says "He that would sail without danger must never come on the main sea". The danger of sailing into the sea and offshore locations for economic and related purposes therefore encompasses the risk of injury, death, loss of valuable properties and investments of economic value, among others. The marine eecosystem particularly the offshore/upstream locations of marine resources such as oil and gas (O&G energy resources), is seen to have inherent potentials of risks of accident, whose occurrence is deemed disastrous to maritime economy, navigation, health of operators, maritime operations, seaborne trade, and productivity [3].

Accidents are defined as the occurrences of unexpected events, leading to damages, economic devaluation, environmental damages, injury or death. Accidents occur as a result of exposure to risks and/or hazardous conditions in an eecosystem. Offshore oil and gas accidents are sub-components of marine accidents which are the occurrences of unforeseen events in the upstream O&G drilling and transportation sub-sector, leading to damages, economic devaluation, environmental damages, injuries and/or death. Offshore O&G accidents most times are ship-based, involving drilling platforms, oil tanker vessels, offshore supply and service boat, etc, following the exposure to sea perils. Upstream accidents associated with O&G operations like other forms of accidents in the marine ecosystem have consequences ranging from output losses associated with death of affected operators, injury idle-time induced output losses, oil spill induced damages to environment and marine biodiversity affecting third party operators, and direct damages and output losses suffered by O&G operators and carriers. The later is referred to in the study as the 'offshore O&G damage accidents economic losses. Therefore, the ship-owners (carriers), offshore O&G operators and shippers are affected by the economic consequences damage accidents associated with upstream oil and gas drilling and transportation. These economic consequences are termed offshore O&G damage accidents economic loss. Its value is equivalent to the value of direct damages done to the accidental investment, property and seaborne oil export and import trade exposed to accidents [4,5]. To ensure sustainable offshore O&G operations cum oil export and import trade, the economic consequences induced by the accidents needs to be adequately indemnified. The output losses occasioned by injury and death accidents associated with offshore O&G operations and the loss of output occasioned by oil spill damages to environment and marine biodiversity affecting third party operators, are the liabilities which the operators as provided in the ILO [6] maritime labour conventions that ship-owners (operators) are liable for injury and death output losses suffered by seafarers (workers in the course of the work [1]. The national laws and the International

maritime Organization (IMO) regulations also make it mandatory that the spillers (O&G operators and ship-owners) are responsible for impacts of the oil spill affected third parties as well as the clean-up (remediation) cost. For the operators to be able to meet their liabilities to the various groups of third parties identified above, the first need to remain in operation/business by securing adequate protection for their individual operations and compensations for economic consequences of direct damages to their investments [5].

In Nigeria, the arbitrary provision in the Insurance Act 2007, for the reservation of between 25% and 45% of the aggregate premium revenue from insured marine risks, as technical reserve fund for compensation of insured marine risks without recourse to the quantum of economic consequences of marine accidents, value of offshore O&G investment and seaborne trade exposed to accidents, and their relationships with each other and with the volume of compensation funds available for indemnification of actual losses; led to the problem of seeming financial insolvency of the local marine underwriters, to timely and adequately provide indemnification to operators and shippers, at the occurrence of insured upstream risks [7-15]. The current marine and offshore O&G accidents economic loss compensation regime in Nigeria therefore faces financial insolvency challenges, induced by the arbitrary provisions in the Insurance Act 2007; posing serious limitations to the timely and adequate compensation insured offshore O&G risks, due to the non-reservation of adequate volume of funds for this purpose [7,8,16].

For example, references [16] and [17], reports indicate that while the average rate of growth of marine underwriters premium income is 591782448.5 naira per annum, the average rate of growth of offshore accidents economic loss is 761572968.5 naira per annum, and the average rate of growth of compensation funds maintained to ensure underwriters financial solvency for compensation of insured O&G accidents risks is 135789339.4 naira per annum. This supports the findings of reference [8] that there is no significant difference between compensation funds reserved by underwriters to maintain financial solvency for the compensation of insured marine risks and the quantum of economic consequences induced by marine accidents in Nigeria between 1999 and 2010. The result of this is the view expressed by shippers and offshore oil and gas operators that, marine underwriters in Nigeria lack financial solvency and capacity to indemnify insured offshore O&G accident risks risks. This perhaps is the cause of the continued refusal of local ship-owners involvement in oil lifting contracts originating in Nigeria, even in the present cabotage regime, by the Nigeria National Petroleum Corporation (NNPC) and the multinational oil companies [18,19].

Thus there is a serious need to develop empirical conditions that will guide marine underwriters in Nigeria in reserving adequate volume of compensation funds for adequate and sustainable indemnification of insured offshore O&G risk based on the relationship between accidents induced economic loss in the sector, value of seaborne trade cum offshore O&G investment, and the volume of compensation funds reserved for offshore O&G risks between 1999 and 2019.

2. Aim and Objectives

The aim of the study is to formulate models to ensure timely, adequate and sustainable compensation of offshore O&G accidents economic loss in Nigeria based on the elasticity of the relationships between offshore O&G accidents economic loss and the value of maritime trade exposed to sea perils on one hand, and between offshore accidents economic loss and compensation funds available for the indemnification of insured offshore O&G risks on the other hand.

The specific objectives of the study include:

1.   To formulate a model of the relationship between Offshore O&G accidents economic loss and the value of maritime trade exposed to sea perils in Nigeria.

2.   To determine the coefficient of elasticity of compensation funds maintained for insured offshore O&G accidents risks to growth in offshore O&G accidents economic loss in Nigeria.

3.   To develop empirical conditions for the adequate reservation of funds for sustainable compensation of offshore O&G accidents economic loss in Nigeria

2.1 Research Questions

1)   Is there significant relationship between offshore O&G accidents economic loss and the value of maritime trade exposed marine perils in Nigeria?

2)   What is the elasticity coefficient of offshore O&G accidents economic loss to growth in offshore accidents economic loss in Nigeria over the years?

3)   What empirical conditions will ensure the reservation of adequate volume of funds for the sustainable compensation of insured offshore O&G accidents risks in Nigeria?

2.2 Literature Review

The importance of the need for the economic sustenance of operations in the offshore O&G energy subsector of the marine industry in Nigeria cannot be overemphasized. This is because, the offshore oil and gas sector remains the dominant foreign exchange earner, one of the cash cows, and economic life wire of the Nigerian nation. Available statistics by the Nigeria Maritime Administration and Safety Agency (NIMASA) suggests that, over 2000 offshore service vessels satisfy the logistics needs of the offshore O&G energy sector in Nigeria. Reference [20] notes that, over 272 mobile offshore drilling units (vessels) and floating production storage and offloading systems (FPSO's) are involved in O&G operations offshore Nigeria; while Nigeria Ports Authority (NPA) [21] statistics indicate a daily increasing trend in the number of tanker vessels that call to Nigerian ports and crude oil terminals for cargo lifting and discharge.

The Nigerian O&G sector over the years, have had its fair share of accidents ranging from fire, explosion, collision, contact, grounding to blowouts; leading most times to catastrophic losses of life, material investment and oil cargo losses and the associated economic devaluation [22,23]. For example the January 16th 2012 explosion and fire on the

drilling rig run by Chevron Nigeria Limited offshore Nigeria had severe economic consequences with usually a long term economic impact on the economy. Reference [24] in a study on the cost estimation of the economic impact of oil and gas spill in Nigeria estimated the total value of oil and gas cargo lost following accidents in the upstream energy sector in Nigeria between 2005 and 2010 at three billion, two hundred and seventy-three million, three hundred and forty-eight thousand, two hundred and twelve naira (N3, 273, 348, 212). The study puts the average value of oil cargo lost at six hundred and fifty-four million six hundred and sixty-nine thousand six hundred and fourty-two naira (654,669,642 naira) per year over the period [24]. Apart from the financial loss to the economy occasioned by O&G cargo losses, the damages to the ship and drilling platforms also have economic consequences which form major component of the aggregate economic impacts of offshore O&G accidents [25]. To ensure sustainable upstream oil and gas operations including lifting and transportation of oil cargo, there is need for the optimal compensation of the economic impact of offshore O&G accidents though the uses of instruments of risk transfer.

The International Union of Marine Insurers (IUMU) [17] report that, between 2007 and 2014, a total of 1217200000USD was spent as insurance premium for the purchase of marine/energy policies to cover offshore O&G accident risks. The IUMI [17] report reveals that an average of one hundred and fifty million, one hundred and fifty thousand (15215000 USD) was spent as premium cost for insurance cover of offshore O&G accident risks in Nigeria. The Nigeria Insurers Association (NIA) [16] however report that, offshore O&G accidents economic loss levels between 2006 and 2013 was an average of three billion two hundred and thirty-four million two hundred and fourty-eight thousand naira (3234248000 naira) per annum over the period. The figure-1 below summarizes the economic loss occasioned by accidents in the offshore O&G sub-sector, insurance cost (premium) for offshore O&G accidents risk, value of seaborne oil export trade in Nigeria between 2006 and 2010.
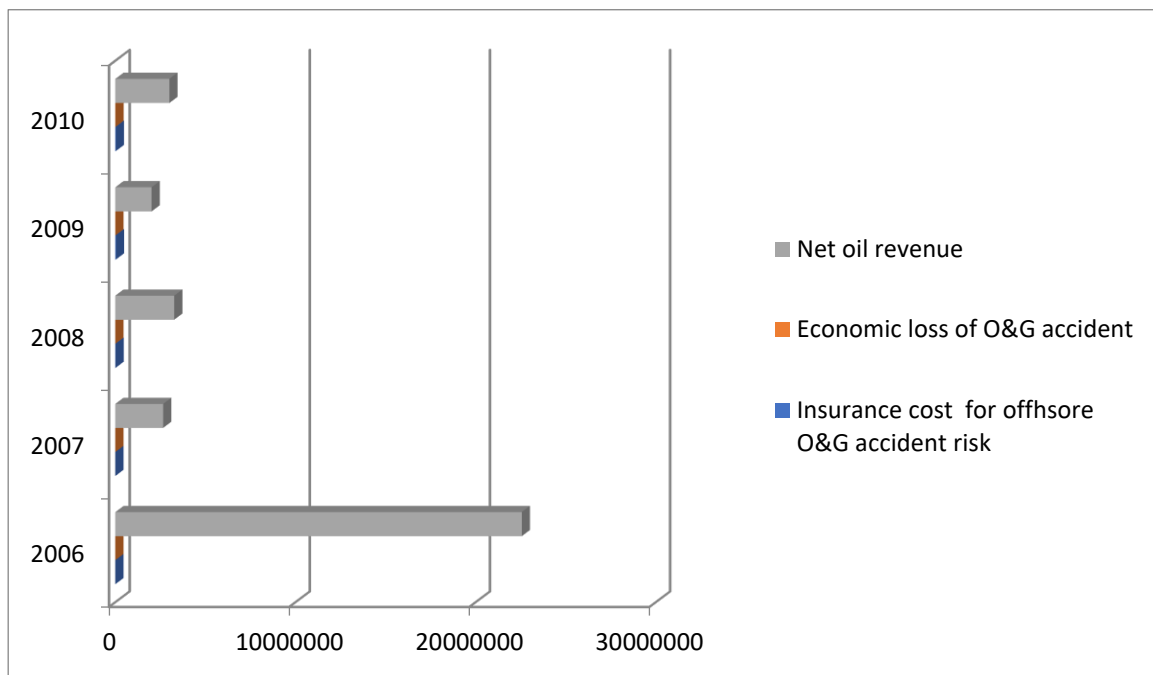
Figure1: Bar chart showing O&G accidents economic loss, insurance cost for offshore O&G risks, and GDP oil and gas between 2006 and 2010. Source: Prepared by author with data from CBN (2014), IUMU (2018).

Statistics from the CBN [26] and the NIA [16] indicate that the aggregate of national output between 2010 and 2014 is about 4.2Trillion naira. The market capitalization of quoted maritime companies in Nigeria over the same period is an aggregate of fourty-nine billion five and six million naira (N49506790000) while aggregate cost of maritime damage accidents on the economy compensated by marine underwriters is about fourty-two billion five-hundred and sixty-two million naira (N42562732290). The implication is that an average of about Eight billion, one-hundred and twelve million naira (N8112546460) was lost per annum over the period due upstream accidents while the market capitalization of quoted maritime companies over the same period is an average of about Nine billion, nine-hundred and one million naira (N9901358300) per annum. This quantum of loss should be adequately compensated for, by the underwriters, otherwise, sustainable maritime operations cannot be guaranteed at the long-run. To ensure adequate, timely and sustainable indemnification losses, marine underwriters must maintain financial solvency by reserving adequate level of funds to compensate affected operators following the occurrence of the insured marine risks.

Studies by the international monetary Fund [7] and [8] faulted the arbitrary reservation of between 25% and 45% of premium revenue of marine underwriters in Nigeria, for purposes of compensating insured unexpired marine risks. Both studies found that local underwriters following the adoption of the arbitrary reservation of between 25% and 45% compensation funds lack the financial solvency and capacity to adequately and time indemnify offshore O&G accidents risks, the same goes to other marine risks.

Studies by references [19] and [18] also identified the problem of financial insolvency of marine underwriters for timely and adequate provision of indemnification for insured offshore O&G risks following which the multinational oil and gas companies and the Nigeria National Petroleum Corporation have over the years continued to deny crude oil lifting contract to local ship-owners whose ships are insured locally without P&I back-up.

The studies did not however provide any models based on empirical evidence to enable underwriters reserve adequate volume of funds to overcome the problem of financial insolvency for timely and adequate compensation of insured offshore O&G accidents economic loss relative to value of seaborne O&G trade exposed to accidents and the value of funds reserved for the compensation of offshore O&G risks over the years. The aforementioned is the knowledge gap which the current study has provided.

3. Data and Methods

The study ex-post research design in which time series secondary data was used for the study. Time series data on offshore O&G damage accidents economic loss, value of maritime trade exposed to accidents in the upstream O&G drilling and transportation sub-sector and compensation funds maintained by marine underwriters for insured offshore O&G risks were sourced from secondary sources from the Nigerian Insurance Digest (NIA), the International

Union of marine Underwriters (IUMU), and Central Bank Statistical Bulletin, various editions.

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The first objectives of the study seeks to the determine of relationships between offshore O&G accidents economic loss and the value of maritime trade exposed to accidents in Nigeria between 1999 and 2019. The second objective seeks to estimate the coefficients of elasticity composition funds reserved for offshore accidents economic loss to changes in the value of offshore O&G accidents economic loss over the period. The results of both objectives will provide basis for developing empirical conditions for timely, adequate and sustainable compensation of offshore O&G accidents economic loss in Nigeria. The OLS multiple regression analysis was used to achieve the first objective, while the log-linear constant elasticity model was used to estimate coefficients of elasticity based on both multiple and simple log-linear regression approaches The model specifications are as shown below:

Using the multiple regression model approach, we write that:

$$\llbracket OFAL \rrbracket\_t = \beta\_0 + \beta\_1\ EXPSTRADEt + \beta\_2\ \llbracket IMPSTRADE \rrbracket\_(t) + \varepsilon\_t \text{------(1)}$$

Where;

EXPSTRADEt = Value of Seaborne Oil Export trade over the period t.

IMPSTRADEt = value of seaborne Oil import trade in period t.

OFFALt = offshore O&G damage accidents economic loss over the period

β0 = Intercept

β1, β2, β3 = regression Coefficients.

For purposes of determining the elasticity of the relationships of the level of changes in offshore O&G damage accidents economic loss as a result of changes/growth in value of maritime trade (seaborne oil export and import trade) exposed to accidents; we defined the coefficient of elasticity mathematically as the ratio of percentage changes in quantum of maritime trade (seaborne oil export and import trade) to percentage changes in offshore O&G accidents economic loss. Using the double-Log-linear (constant elasticity) model, we transform equations (1) into Log-linear models by taking the natural log of both sides as follows:

$$\llbracket InOFAL \rrbracket\_t = \beta\_0 + \beta\_1\ InEXPSTRADEt + \beta\_2\ \llbracket InIMPSTRADE \rrbracket\_t + \varepsilon\_t \text{---(2)}$$

In the above double-log models, both coefficients of regression β1 and β2 estimate the coefficients of elasticity of offshore O&G damage accidents economic loss to percentage changes in the values of maritime trade over the period [27].

Where:

Eio = β_2= Elasticity of offshore O&G damage accidents economic loss to changes in seaborne oil import trade

Eeo = β_1= Elasticity of offshore O&G damage accidents economic loss to changes in seaborne oil export trade.

IMPSTRADEt = value seaborne oil import trade over the period

EXPSTRADEt = value of seaborne export trade over the period

$\triangle$〖OFAL〗_t = Changes in offshore damage accidents economic loss

〖OFAL〗_t = value of offshore damage accidents economic loss over the period.

To achieve the second objective of the study aimed at determining the coefficient of elasticity of compensation funds maintained for insured offshore O&G risks to changes in offshore O&G accidents economic loss over the period, we employed the log-linear (constant elasticity model) specified as show below:

InOGPREt = β0 + β1InOFFALt + e --- (3)

Where:

β1 = elasticity coefficients (Gujarati and Porter, 2009).

Using the constant elasticity model/double-lo linear model, we established the coefficients of elasticity of compensation funds (OGPREt) maintained for offshore damage accidents risks to changes in offshore damage accidents economic loss over the period [27].

Also note that, when the coefficient of elasticity is less than 1, the response is said to be inelastic. When it is greater than 1, it is said to be elastic; and when it is equal to 1, it is unit elastic.

If E < |1|→ inelastic response

If E > |1|→elastic

If E = |1|→unit elastic

4.0 Results and Discussion

Table1: Formulating the relationship between offshore O&G damage accidents economic loss and growth in maritime trade in Nigeria

Test-statistic	Coefficient(s)
Mean in dependent variable *IMPSTRADEt*	9692043330000.0
Mean independent variable *EXPSTRADEt*	12728949979230.8
Mean dependent variable OFF*ALt*	4052307923.1
Regression coefficient *β1*	0.211
Regression coefficient *β2*	0.121
Regression Constant *β0*	123404.891
Standard error of regression	3604939.633
R-square	0.62

F-statistic		5.317
Prob(F-statistic)		0.017
F-critical		3.71
T-statistics		**P-value(s)**
Parameter(s)	Coefficient(s)	
t-score (β_1)	1.518	0.616
t-score (β_2)	0.716	0.491

Source: SPSS output. Author's calculation

The result of table-1 above shows the significance and nature of the relationship between offshore O&G sector damage accidents economic loss and growth in seaborne oil and gas import and export trade (maritime trade). The result shows that average value of seaborne import and export trade per annum over the period is 9692043330000.0 naira and 12728949979230.8 naira respectively with respective standard deviations of 3496980443.013 and 3787959485.2408. The mean offshore damage accidents economic loss suffered by the economy over the period covered in the study is 4052307923100 naira per annum with standard deviation of 3156947.694. The mathematical model depicting the relationship between offshore damage accidents economic loss and growth in maritime trade over the period covered in the study is:

OFFALt =   123404.891 + 0.321IMPSTRADEt + 0.121EXPSTRADEt + e ------------ (4)

This implies that for each unit increase in each of seaborne import and export trade, offshore damage accidents economic loss increases by an average rate of 0.321 and 0.121 respectively. The coefficient of determination R-square which measures the explanatory power of the model is 0.62. This indicates that about 62% variation in offshore accidents economic loss over the period is explained by growth in maritime trade.

The significant relationship between offshore O&G damage accidents economic loss and growth in maritime trade provides support for the estimation of the coefficients of elasticity of offshore damage accidents economic loss to changes in the values of each type of maritime trade. The coefficients of elasticity enables the development of empirical relationships that enables marine underwriters to reserve compensation funds to ensure financial solvency for timely, adequate and sustainable indemnification of insured offshore O&G risks in the Nigerian maritime industry. Table-2 below provides the coefficients of elasticity of offshore O&G damage accidents economic loss to changes/growth in seaborne import and export trade over the period.

Table-2: Coefficients of Elasticity of offshore O&G damage accidents Economic loss to changes in value of maritime trade between in Nigeria

Variable	*Coefficient(s)*
Test-statistics	
Mean dependent variable *InOFFAL$_t$*	14.6606
Regression constant	-41.769
Mean dependent variable *InIMPSTRADE$_t$*	23.2248
Mean Independent variable *InEXPSTRADE$_t$*	22.9363

Elasticity coefficient $\beta_1 = E_{io}$	0.055
Elasticity coefficients of elasticity $\beta_2 = E_{eo}$	2.376
R-square coefficient	0.538
F-statistic	5.072
F-critical	3.71

Source: SPSS output. Note: if $E<1,=$ *inelastic;* if $E\geq1, =$ *is elastic*

The coefficient of elasticity of offshore O&G damage accidents economic loss to changes/growth in seaborne import trade Eio over the period covered in the study is 0.055; This indicates an inelastic relationship; implying that a 1% growth in seaborne import trade produces a small increase of about 0.055% in offshore O&G damage accidents economic loss. This is good for the economy and stakeholders in maritime trade as it depicts that negligible damage is done to the value of seaborne oil import trade affected by marine accidents. It however holds vital information for the development of the marine underwriting sector, particularly in the reservation of compensation funds to ensure solvency of marine underwriters in ensuring timely, adequate and sustainable compensation of insured offshore O&G risks. Since a 1% growth in seaborne import trade increases offshore O&G damage accidents economic loss by 0.055%; to timely and adequately indemnify insured offshore O&G damage accidents economic loss as it relates to import trade, marine underwriting policy must provide that compensation funds for insured seaborne O&G import trade increase by an amount greater than or proportional to 0.055% of the mean or previous year offshore O&G damage accidents economic loss value, for every 1% growth in seaborne O&G import trade.

Furthermore, the coefficient elasticity Eeo of offshore O&G accidents economic loss to growth in seaborne O&G export trade is 2.376. This depicts an elastic relationship. The implication of this is that over the period covered in the study, a 1% growth in seaborne O&G export trade increases offshore O&G damage accidents economic loss by 2.376%; adequate compensation of offshore O&G damage accidents economic loss in the seaborne O&G export trade sector requires that marine underwriting policy must provide that compensation funds increase by an amount greater than or equal to 2.376% of the mean or preceding year value of offshore O&G accidents economic loss, for every 1% growth in the value of sseaborne export trade.

Based on the respective coefficients of elasticity of offshore O&G accidents economic loss to growth in maritime trade; we determined the empirical conditions that can enable marine underwriters to remain financially solvent by maintaining sufficient volumes of compensation funds for insured offshore O&G risks as shown in the table-3 below.

Table-3: Empirical conditions that sufficiently ensures underwriters financial solvency, for timely, adequate and sustainable compensation of offshore O&G damage accidents economic Loss in Nigeria

s/n	Variable(s)	Elastic relations between variables	Policy effect and Implication for financial solvency, timely adequate and sustainable compensation of insured marine risks	Remarks
1	*IMPSTRADE*	1% increase	For each 1% increase in value of seaborne import trade	Similalrly, for X% increase in IMPSTRADE>1%; ΔOGRE$\geq$X(0.055%) of mean OFAL$_t$ or preceedng year value Y$_o$, whichever is greater
	OFAL$_t$	0.055% increase	Increase/ΔOGPRE$\geq$0.055% of mean value of OFAL$_t$; or ΔOGRE$\geq$0.055% of preceding year value (Y$_o$) of OFAL$_t$ [where Y$_o$>mean value of OFAL$_t$]	
2	*EXPSTRADE*	1% increase	For each 1% increase in export:	For X% increase in EXPSTRADE>1%; ΔOGRE$\geq$X(2.38%) of mean OFAL$_t$ or preceedng year value Y$_o$, whichever is greater.
	OFAL$_t$	2.38% increase	Increase/ΔOGRE$\geq$2.38% of mean value of OFAL$_t$; Or ΔOGRE$\geq$2.38% of preceding year value (Y$_o$) of OFAL$_t$ [when Y$_o$>mean value of OFAL$_t$]	

Source: Author's calculation.

The implication is that for underwriters to maintain financial solvency and ensure timely and adequate compensation of insured offshore O&G risks, compensation funds reserved for each type of seaborne O&G trade must increase proportionately by amounts equal to or greater than the respective coefficients of elasticity of offshore O&G accidents economic loss to growth in maritime trade.

For a percentage (1%) increase in seaborne O&G import trade, increase in compensation funds reserved by underwriters for insured O&G risks (ΔOGRE) must be greater than or equal to 0.055% (ΔOGRE$\geq$0.055%) of mean value of offshore O&G accidents economic loss over the period (OFALt); or where the preceding year value (Yo) of OFALt is greater than the mean value, increase in compensation funds reserved by underwriters for offshore O&G risks must be greater than or equal to 0.055% (ΔOGRE$\geq$0.055%) of preceding year value of offshore accidents economic loss (Yo).

For a percentage (1%) increase in seaborne O&G export trade, increase in compensation funds reserved by underwriters for insured O&G risks (ΔOGRE) must be greater than or equal to 2.38% (ΔOGRE$\geq$2.38%) of mean value of offshore O&G accidents economic loss over the period (OFALt); or where the preceding year value (Yo) of OFALt is greater than the mean value, increase in compensation funds reserved by underwriters for offshore O&G risks must be greater or equal to 2.38% (ΔOGRE$\geq$2.38%) of preceding year value of offshore accidents economic loss (Yo).

Table-4: Elasticity of compensation funds maintained for insured offshore O&G risks to changes in offshore O&G accidents economic loss in Nigeria.

Test-statistic	Coefficient(s)
Mean dependent variable **In*OGRE$_t$***	17.4191
Mean independent variable **In*OFFAL$_t$***	14.6606

Mean **$OGRE_t$**	41139083867.69
Mean **$OFFAL_t$**	4052307948.6923
Regression coefficient $\beta_1 = E_{ro}$	0.037
Regression Constant β_0	16.879
Standard error of regression	1.722
R-square	0.57
T-score	2.415
Prob(t-statistic)	0.0439
t-tabulated	1.71

Source: Spss output Note: if *E<1= inelastic.; if E≥1= elastic relationship*

The result of the analysis on shows that the coefficient of elasticity of compensation funds reserved for insured offshore O&G risks to growth in offshore O&G damage accidents economic loss over the period is 0.037. The relationship is however inelastic since 0.037<1. This indicates that marine underwriters responses to reservation of compensation funds for insured offshore O&G risks to growing trend of offshore O&G damage accidents economic loss over the period is inelastic. Compensation funds for insured offshore O&G risks do not increase proportionately in line with growth in offshore O&G accidents economic loss. The equation showing the mathematical relationship between compensation funds reserved for insured offshore O&G risks to increasing offshore O&G damage accidents economic loss over the period is:

InOGREt = 16.879 + 0.037InOFFALt + e ------------------------------------- (5)

The t-score is 2.42 and t-tabulated is 1.71 (ie: 2.42<1.71); shows that there is a significant relationship between the compensation funds maintained for insured offshore O&G risks and the value of offshore O&G accidents economic loss over the period. The result also shows that the average volume of financial maintained by underwriters for compensation of offshore O&G risks per annum over the period covered in the study is 41139083867.69 naira while the average amount lost due to offshore O&G accidents per annum over the same period amounts to 4052307948.6923 naira.

The coefficient of elasticity of compensation funds for insured offshore O&G damage accidents risks to changes in offshore O&G damage accidents economic loss of 0.037 implies that a 1% increase in offshore O&G damage accident economic loss produced a 0.037% increase in reserved funds aimed at maintaining the solvency of marine underwriters for timely, adequate and sustainable compensation of insured offshore O&G risks over the period. By implication, compensation funds for indemnifying offshore O&G accidents economic loss does not increase proportionately with or above the offshore O&G damage accidents economic loss rate of increase. This endangers the capacity of marine underwriters to maintain financial solvency for timely and adequate indemnification of insured offshore O&G risks. This finding is in line with the findings of references [7] and [8]. To ensure that underwriters maintain financial solvency to ensure timely, adequate and sustainable indemnification of offshore O&G accidents economic loss; compensation funds for offshore

O&G damage accidents economic loss must be made to increase at a rate greater than or proportional to 1% of the mean or previous year value of offshore O&G accidents economic loss, for every 1% increase in offshore O&G accidents economic loss in Nigeria. In order to ensure that marine underwriters maintain sufficient financial solvency at all times to ensure timely, adequate and sustainable indemnification of insured offshore O&G accidents economic loss, the following conditions shown in the table-5 below are developed based on the elasticity coefficients of compensation funds reserved for insured offshore O&G risks to changes in offshore damage accidents economic loss earlier estimated. See table-6 below.

Table-6: Empirical conditions that sufficiently ensure underwriters maintain financial solvency for timely, adequate and sustainable compensation of offshore O&G accidents economic loss in Nigeria based on the elasticity Coefficients.

s/n	Variable	Mean	Elastic relations between variables	Effect and Policy Implication for solvency, timely, adequate and sustainable compensation of insured marine risks	Remarks
1	$OFFAL_t$	4052307948.69	1% increase	For every 1% increase in $OFFAL_t$:	X% change in $OFAL_t$ when X>1; increase/$\Delta OGRE \geq X\%$ of mean $OFAL_t$ Or $\Delta OGRE \geq X\%$ of preceding year value of $OFAL_t$ (Y_o), where Y_o> mean $OFAL_t$
	$OGRE_t$	41139083867.69	0.037% increase	Increase/$\Delta OGRE_t \geq 1\%$ of mean $OFFAL_t$ or $\Delta OGRE \geq$ Preceeding year value of $OFAL_t$ (Y_o), when Y_o>mean $OFAL_t$	

Source: Author's calculation

The conditions expressed in the table-6 above provides that for every X% increase in offshore O&G accidents economic loss, the compensation funds reserved for the insured offshore O&G risks must increase by an amount proportional to or greater than the X% increase in offshore O&G accidents economic loss; if the underwriters must maintain financial solvency to ensure timely and adequate indemnification of the insured offshore O&G risks.

It also implies that, for a percentage (1%) increase in offshore O&G accident economic loss, increase in compensation funds reserved by underwriters for indemnifying offshore O&G accident economic loss ($\Delta OGRE$) must be greater than or equal to 1% ($\Delta OGRRE \geq 1\%$) of mean value of offshore accidents economic loss over the period ($OFALt$). Where the preceding year value (Ys) of OFALt is greater than the mean value, increase in compensation funds reserved by underwriters for indemnification of offshore O&G accidents economic loss must be greater than or equal to 1% ($\Delta OGRE \geq 1\%$) of preceding year value of offshore O&G accidents economic loss (Yo).

5. Conclusions

Since a 1% growth in seaborne O&G import trade increases offshore O&G damage accidents economic loss by 0.055%; to ensure that marine underwriters maintain financial solvency for timely and adequate indemnification of insured seaborne O&G import trade, compensation funds for insured seaborne O&G import trade must be increased by an amount greater than or proportional to 0.055% of the mean or previous year offshore O&G damage accidents economic loss value, for every 1% growth in seaborne import trade.

Furthermore, To improve the financial solvency of marine underwriters for timely and adequate compensation of offshore seaborne O&G accidents economic loss, marine underwriters must ensure that the volume of compensation funds reserved for compensation of insured O&G export trade increase by an amount greater than or equal to 2.376% of the mean or preceding year value of offshore O&G accidents economic loss, for every 1% growth in the value of sseaborne O&G export trade. Compensation funds for indemnifying offshore O&G accidents economic loss over the years does not increase proportionately with or above the rate of increase of offshore O&G accidents economic loss. To ensure that underwriters maintain financial solvency to ensure timely, adequate and sustainable indemnification of offshore O&G accidents economic loss; compensation funds reserved for offshore O&G damage accidents economic loss, must be made to increase at a rate greater than or proportional to 1% of the mean or previous year value of offshore O&G accidents economic loss, for every 1% increase in offshore O&G accidents economic loss in Nigeria.

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