



## Modeling shipping accidents economic loss and the compensation in Nigeria

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### Abstract

The arbitrary reservation of between 25 and 45 % of premium revenue as funds for the compensation of insured unexpired marine risks by underwriters in Nigeria, in line with local insurance regulations, has created a problem of financial insolvency, making it impossible for underwriters to provide timely and adequate compensation for insured shipping risks. The aim of the study is to overcome this challenge by formulating models based on the coefficient of elasticity of the relationships between shipping accident economic loss, the value of seaborne trade, and compensation funds maintained for insured shipping risks. 21 years of time series data from 1999 and 2019 were obtained from secondary sources. Log-log constant elasticity model was used to analyze the data. The results indicate that, for each 1 % increase in shipping accident economic loss, compensation funds maintained for shipping accident economic risks increase by 0.364 %. The policy implications are discussed and models developed for the reservation of funds for sustainable compensation of insured shipping risks are developed.

### 1. Introduction

The safety and security of the shipping trade and the supply chain has been identified as a component factor that influences a shipper's choice of carrier, port, and shipping routes. It has also been identified that a carrier's preference for trade types, routes, and ports is influenced by the prevailing level of safety and security which, in turn, influences the long-run sustainability of seaborne trade and commerce in a given economy. While the safety of the shipping trade and supply chain is concerned with the protection of these against the occurrences of accidents and/or unforeseen events that could induce damages to seaborne trade, vessels, and the environment, as well as injuries to shipping crew, shipping trade and supply chain security is concerned with the protection of seaborne trade and the supply chain from willful and malicious attacks, such as piracy and terror attacks, with the capacity to cause damage and/or loss to the shipping trade, the environment, and vessels, as well as injury to crew. It is important to note that both accidents and willful/malicious attacks (safety and security incidents) cause disruption of the supply chain and the devaluation of shipping trade and, as a result, threatens sustainable seaborne trade, the supply chain, and shipping operations. Therefore, to ensure sustainable seaborne trade in the long run, damages, devaluations, and disruptions of shipping trade and supply chain operations caused by accidents

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must be timely, adequately, and sustainably mitigated, indemnified, and/or compensated through the instrument of marine underwriting practice.

We define shipping accidents in the context of this work as aspects of marine accidents which involves the occurrence of unforeseen events leading to damages to investments, injury and death of crew, and damage to the marine ecosystem among other costs, caused by the exposure of ships, equipment, properties, and seaborne trade to risks and marine perils, provided that the accidental objects are in transit at sea or being harnessed for sea movement, in port or in dockyards, and can be protected by a policy of marine insurance. It is immaterial whether the vessel or object involved in an accident is sailing or stationary at the point and time of the accident (MAIB, 2008). In line with the opinions expressed by Ando (2004) and Demarco et al. (1997), we classified marine accidents into classes based purely on the nature of economic consequences and impacts, to include: damage accidents (covering shipping accidents losses and offshore oil and gas (O&G) drilling accident economic losses), marine oil spill accidents (marine environmental pollution inducing accidents), marine injury accidents (accidents involving injury to crew), and fatal and/or death accidents (accidents involving the death of members of maritime labor/seafarers). Based on the categorizations above, the social costs of marine accidents encompassing costs to the ship-owners and shippers, as well to society (external individuals and third parties), can be modeled for the purposes of providing adequate compensation.

Shipping accidents, thus, affect majorly carriers (ship-owners) and shippers, who encounter direct damages and losses to ships and seaborne trade. These are the groups that we seek to study in this work, in order to develop sustainable strategies to ensure that they are adequately compensated for sustainable shipping operations. This is because, even when marine accidents induce injuries and deaths of crew and oil spill environmental damages to third parties, the International Labour Organization (ILO, 2006), Maritime Labour Convention (MLC), and the International Maritime Organization (IMO) have long provided frameworks for the compensation of such externality costs by ship-owners, who are liable to compensate the effected external parties. There needs to be in place sustainable strategies, based on empirical information, to ensure that ship-owners, after compensating externality costs, and shippers receive adequate compensations to remain in trade.

Shipping accidents, like all damage accidents, result in adverse changes in the state of the seaborne trade, vessels, and properties involved. The change in state may take the form of economic devaluation occasioned by damage of the investment affected. Trevisani (2007) and Flyvlojerg and Budzier (2011) both agree that the occurrence of accidents bring about a consequence, which is a depreciation or loss in the value of the assets involved, following a change in the state of the asset, and which equally diminishes the extent of the achievement of objective functions. This loss in value represents the impact, cost, or consequences of accidents and, in most cases, is quantifiable in measurable quantities and financial units. Supporting the opinions of Trevisani (2007) and Flyvlojerg et al. (2011), the International Standard Organization (ISO, 2009), identifies that accident risk management and control should create value; meaning that, resources expended to mitigate, control, and manage accidents must be less than the consequences of inaction or the value of the property (salvaged value) after an accident. This suggests that accidents impose costs, consequences, and impact which diminishes the value of the properties and investment involved. This quantitative direct cost or impact of shipping accidents on seaborne trade and maritime investment involved in accidents is determined by subtracting the salvaged value (value after) from the original/actual value before accident. The difference between salvage value (value after accident) of affected shipping trade and original value (value of shipping trade before accident) is, thus, termed the shipping accident-imposed 'economic loss'. Shipping accident economic loss affects objective function maximization negatively. Since the basic objective function of shipping operations must be output maximization to the national economy and gross domestic product (GDP), the rate of shipping accident occurrence and related economic loss levels will obviously

impinge on the full achievement of this objective, thus, imposing the need for adequate and sustainable compensation.

The concept of shipping accident economic loss compensation is an economic loss control and risk management approach targeted at mitigating the financial consequences of shipping accidents (shipping accident economic losses) in order to sustain seaborne trade and shipping operations and protect society against the economic consequences and impacts of such occurrences. In the maritime industry, there exist many loss control measures, such as risk aversion, risk reduction, risk retention, etc., but the most widely adopted practice is marine insurance (risk transfer), which adopts the indemnification principle to provide compensation to maritime operators, shippers, and other stakeholders in the occurrence of insured risks (IUMU, 2011). This practice has, over the years, been developed further by acts of parliament made as compulsory measures for marine and shipping accident loss compensation in Nigeria's shipping industry. This is important because the quest for sustainable development of the blue economy cannot be actualized in the face of random wastages and accidental destruction of the productive capital base occasioned by accidents without a loss control system that provides commensurate compensation for such economic risks via indemnification. The viability, performance, and capacity of such a loss control system to meet the needs of the industry optimally is, however, dependent on the availability of fairly accurate data of the level and quantum of economic risks being occasioned through accidents to the economy.

In Nigeria for example, the United Nations Convention on Trade and Development (UNCTAD, 2014) reports that seaborne container traffic to Nigerian ports stood at two million, seven hundred and twenty thousand, four hundred and twenty two twenty-foot equivalent units (TEUs) (2,720,422 TEUs), representing an average of nine hundred and nine thousand four hundred and seventy four TEUs (909,474 TEUs) per annum between the 2011 to 2013 period. National statistics indicate that the total values of the export shipping trade and the import shipping trade in the year 2013 were 14.735 trillion naira and 9.084 trillion naira, respectively, while the cargo throughput of Nigerian ports, excluding crude oil terminals, in the same year was 76,886,997 million metric tons (CBN, 2014; NBS, 2014; NPA, 2014). Further reports from the Nigerian Ports Authority (NPA) reveals that, in the year 2013, 5,232 ships transited to the ports of Nigeria, while an average of 2,200 offshore service boats serviced the logistics needs of the O&G industry in the coastal trade (NPA, 2014). Reports by the Nigeria Insurance Digest (2017) suggest that the economy lost averages of 1.633 billion naira and 9.160 billion naira, due to shipping accidents and accidents in offshore O&G drilling operations, respectively, each year between 1984 and 2013. However, the current marine underwriting regime in Nigeria seems to lack the capacity to ensure adequate and sustainable compensation of insured shipping risks. Available empirical literature shows a gap in the area of lack of empirical information on the quantum of economic losses in relation to the values of seaborne trade exposed to accidents at sea and the volume of funds reserved for the compensation of insured shipping risks. As a result, there persist arguments and issues about the lack of capacity of the local marine underwriting sector to compensate insured marine and shipping accident economic loss in Nigeria optimally.

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 a technical reserve fund for compensation for insured marine risks (shipping risks, offshore O&G risks, etc.), without recourse to the quantum of marine accident economic loss, value of seaborne trade exposed to sea perils, and their relationships with each other and with the volume of compensation funds available for indemnification of actual losses, has led to the problem of seeming financial insolvency of local marine underwriters. This prevents the timely and adequate provision of indemnification to shippers and operators, in the occurrence of insured marine risks (IMF, 2013; Nwokoro et al., 2015; NIA, 2007, Olukolajo, 2017; Nzeribe, 2019; Babawale, 2013; Chima, 2011; Bello & Olukolajo, 2016; Adekunbi & Nzeribe, 2013).

The current shipping accident 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 of insured shipping risks, due to the non-reservation of an adequate volume of funds for this purpose. This situation endangers the local content development drive in the insurance sector. For example, the Nigerian government's motivation to protect maritime trade and enhance local content development in the local underwriting industry led to inserting a cargo insurance policy into Section 14 (3) of the National Shipping Decree 1987, which stipulates that all public sector contracts for seaborne import and export trade shall be on free on board (F.O.B.) and cost, insurance and freight (C.I.F.) contracts, respectively. The clear policy intent is that local marine underwriters will cover such contracts, to enable them to develop and to reduce the effect of capital flight. In 1997, Insurance Decree No. 2, Section 76, provided that all imports (both private and public sector imports) into Nigeria shall be on cost, insurance and freight basis only, thus recommending that both public and private sector import contracts be insured with local insurers. The above provisions were consolidated by the current regime of the Insurance Act 2007 which, apart from establishing a new capitalization base for all local insurance firms in Nigeria, provided for the maintenance of reserve funds for all types of insured risks of the indigenous underwriting firms, to enable them to maintain solvency for timely and adequate compensation of claims and liabilities (NIA, 2007).

However, the problem with the arbitrary reservation of between 25 and 45 % of premium revenue as a fund for compensation of insured marine risks is that it limits underwriters' capacity to provide timely and adequate compensation to affected parties, as the growth rate of shipping accident economic loss and value of seaborne trade exposed to accidents at sea may push higher than that of funds reserved based on the arbitrary provisions. For example, NIA (2017) and IUMU (2018) reports indicate that, while the average rate of growth of marine underwriters' premium income is 591,782,448.5 naira per annum, the average rate of growth of shipping accident economic loss is 761,572,968.5 naira per annum, and the average rate of growth of compensation funds maintained to ensure underwriters' financial solvency for compensation of insured shipping risks is 135,789,339.4 naira per annum. This supports the findings of Nwokoro et al. (2015) and the IMF (2013), 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 marine accident economic loss in Nigeria between 1999 and 2010. The result of this is the view expressed by shippers and maritime operators that marine underwriters in Nigeria lack financial solvency and capacity to indemnify insured marine 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 NNPC and the multinational oil companies (Onuoha, 2019; Adegbayi, 2017).

There is, therefore, a need to develop strategies for the timely, adequate, and sustainable compensation of shipping accident economic loss in Nigeria based on the empirical relationships between the value of shipping trade exposed to sea perils, shipping accident economic loss values, and the volume of funds reserved for the compensation of insured shipping/marine risks over the years. To do this, there is a need to address many questions, such as the existence of significant relationships or otherwise between shipping accident economic loss and the value of seaborne trade in Nigeria, what constitutes the coefficient of elasticity of shipping accident economic loss to changes in the value of shipping import and export trade in Nigeria, what constitutes the coefficient of elasticity of compensation funds available for insured shipping risks to changes in shipping accident economic loss in Nigeria and, finally, what empirical conditions exist between the identified variables for the reservation of compensation funds for the sustainable indemnification of insured shipping risks in Nigeria to be determined. In line with the research questions, the aim and objectives of the study are identified in section 2 below.

## 2. Aim and objectives

The aim of the study is to formulate models to ensure timely, adequate, and sustainable compensation of shipping accident economic loss in Nigeria based on the elasticity of the relationships between shipping accident economic loss and the value of seaborne trade on one hand, and between shipping accident economic loss and compensation funds available for the indemnification of insured shipping risks in Nigeria on the other hand.

The specific objectives of the study include:

1. To formulate a model for predicting shipping accident economic loss based on the relationship with the value of seaborne trade exposed to sea perils in Nigeria.
2. To determine the coefficient of elasticity of shipping accident economic loss to changes in the value of shipping import and export trade in Nigeria.
3. To estimate the coefficient of elasticity of compensation funds available for insured shipping risks to changes in shipping accident economic loss in Nigeria.
4. To develop empirical conditions for the reservation of compensation funds for the sustainable indemnification of insured shipping risks in Nigeria.

## 3. Literature review

Susan (2001) notes that marine underwriting and Protection and Indemnity (P&I) insurance provides a veritable means of protecting seaborne trade and shipping operations from the impacts of shipping accidents. Thus, by the deployment of marine insurance cum P&I insurance, shippers and ship-owners receive indemnification for all financial losses occasioned by shipping accidents, provided such seaborne trade, vessels, and shipping operations affected by such accidents are insured against the risks of accidental loss, damage, and/or devaluation. Susan (2001) notes that the development of P&I insurance over the years is consequent from the fear expressed by most ship-owners on the incapacity, inability, and insolvency of most public and private sector marine insurance companies and underwriters to provide adequate cover and indemnify externalities and third party claims as they occur. It is important to note that, while marine insurance companies provide "hull and machinery" cover for ship-owners, and cargo cover for shippers, P&I clubs provide cover for open-ended risks that traditional insurance companies are reluctant to insure. For example, protection and indemnity clubs provide cover for:

1. A carrier's third-party risks for damage caused to cargo during carriage.
2. War risks.
3. Risks of environmental damage, such as oil spills and pollution.

Tyne (2012) agrees that most regular marine insurance companies are reluctant to provide cover for the above identified risk types, while also opining that shippers and ship-owners in most countries still bemoan the incapacity of regular marine insurance companies to maintain solvency for timely, adequate, and sustainable compensation of insured shipping risks. This is exactly the major challenge in Nigeria, where the current marine insurance regulations made arbitrary provisions for the reservation of between 25 and 45 % of premium income for the indemnification of insured unexpired marine risk; a situation which has limited the capacity of the underwriters to maintain solvency for the timely and adequate indemnification of insured shipping risks. The nearest alternative is for local and other ship-owners operating in the Nigerian maritime sector to opt for P&I clubs to protect their interests in the ships. Shippers, on the other hand, are barred by existing local laws from purchasing insurance protection for import and export shipping trade from foreign countries, thus subjecting Nigerian shippers to a chaotic situation where the existing local laws, while barring the purchase of protection for their shipments from foreign underwriting firms, also hinder the shippers from receiving timely and adequate compensation for risks insured locally. In Nigeria, there is currently no locally developed Protection & Indemnity club; however, the operations of internationally established P&I clubs do not bar willing foreign ship-owners and operators from memberships; Nigerian ship-owners with strong affinity to secure sure and adequate

protection for their vessels should opt to join foreign P&I clubs. One major obstacle to this desire is the huge financial resources in foreign currency required to actualize it. Thus, local ship-owners like the shippers have continued to face the risk of making do with seeming financial insolvency and the consequent inadequate protection being provided by local marine underwriters in Nigeria.

In Nigeria, there exist a plethora of marine insurance companies and underwriters working to provide insurance cover and protection for seaborne trade and shipping operations in Nigeria. The activities of these companies are regulated by the Nigerian Insurance Commission (NAICOM) within the legal framework provided by the Nigeria Insurance Act of 2007 as amended. Notwithstanding the existence of numerous marine underwriting firms providing insurance protections for seaborne trade and shipping operations in Nigeria, the seeming incapacity and insolvency of the underwriters in providing timely and adequate indemnification of marine claims remain persistent (IMF, 2013). For example, analysis of the financial performance of eight major insurers in the industry for the 2018 financial year show that Gross Premium (GP) for marine insurance stood at N8.8 billion, while gross claims paid was N4.5 billion. When viewed peripherally, this suggests a good business outing for the insurance firms in that business year, as premium revenue far exceeded marine claims. It equally suggests the possession of adequate capacity to settle claims for insured marine risks. However, the provision of the Insurance Act 2007 for the reservation of between 25 and 45 % of the premium revenue as a technical reserve for unexpired marine risks gives latitude to the underwriters to employ the premium revenue for other forms of investment and as part of operating cost, thus rendering most marine underwriting companies insolvent and incapable of providing adequate, timely, and sustainable indemnification of insured risks (IMF, 2013; Nwokoro & Nwokedi, 2015; Nwokedi, 2021).

As earlier identified, the current loss compensation regime in Nigeria is based on the Nigeria Insurance Act of 2007, which allows marine underwriters latitude to maintain between 25 % to 45 % of aggregate premium income earned from each class of marine risk insured as a technical reserve and/or fund aimed at maintaining the solvency of the underwriters and ensuring that they have capacity for timely and adequate compensation of losses (Nwokoro et al., 2015; NIA, 2007; IMF, 2013). This arbitrary choice of between 25 to 45 % of premium income as a reserve fund to maintain financial solvency for timely and adequate indemnification of unexpired insured risk has, however, been faulted and identified as the major reason that marine underwriters in Nigeria at the point of occurrence of insured loss show gross insolvency and incapacity to timely and adequately pay claims arising from such losses.

For example, studies by the International Monetary Fund (IMF, 2013) also faulted the solvency regime of the Nigerian underwriting sector in general, noting that the basis for the maintenance of technical reserve and/or reserve funds for the compensation of unexpired risks does not guarantee that underwriters remain financially solvent to ensure timely and adequate compensation of insured risks. Similar studies by Nwokoro and Nwokedi (2015) also note that there is no significance difference between compensation funds maintained for insured marine risks and the value of marine accident economic loss recorded between 2007 and 2016, asserting that local underwriters lack capacity and financial solvency to indemnify losses when they occur.

Studies by Olukolajo (2017), Nzeribe, (2019), and Babawale (2013) indicate that the costs occasioned by marine accident damages to shippers, ship-owners, third parties, and other externality costs in Nigeria are rarely adequately compensated, as operators deny liability and/or seek avenues to limit their liability for such losses. This has led to a situation of continued conflict between the affected third parties, ship-owners, and other stakeholders operating in the maritime sector in Nigeria. It is, therefore, evident that the current shipping accident loss compensation regime, strategy, and practices are marred with the challenges of late and/or inadequate compensation of insured risk as a result of insolvency of marine underwriters at the time of the loss. This, in turn, is occasioned by the arbitrary choice of between 25 and 45 % of earned premium revenue as a reserve fund for the compensation of unexpired marine risks (IMF, 2013; Nwokoro et al., 2015).

Statistical evidence from the Central Bank of Nigeria (CBN, 2018) statistical report indicates that the average annual value of seaborne export and import trade in Nigeria between 2007 and 2016, representing value of trade exposed to the risks of accidental loss at sea, for which maritime operators seek protection by means of marine insurance cover, is about 11.5 trillion naira and 8.7 trillion naira, respectively, per annum. According to the CBN (2018), while the rate of growth of the value of seaborne export trade is an average of 2.2 billion naira per annum, the average rate of growth of seaborne import trade was 5.7 billion naira per annum between 2007 and 2016. However, statistical evidence from the International Union of marine underwriters (IUMU, 2018) and the Nigeria Insurers Association (NIA, 2017) reveal that, while the average value of premium revenue of underwriters in Nigeria between 2007 and 2016 was 18.9 billion per annum, marine damage accident economic loss over the period was an average of 3.4 billion naira per annum, while the average amount of compensation funds maintained as a reserve by marine underwriters to ensure solvency for timely and adequate compensation of insured risks, in the event of accidental damages, was 3.9 billion naira per annum.

The reports by the NIA (2017) and IUMU (2018) indicate that, while the average rate of growth of marine underwriters' premium income is 591,782,448.5 naira per annum, the average rate of change (growth) of shipping damage accident economic loss is 761,572,968.5 naira per annum, and the average rate of growth of compensation funds maintained as a technical reserve to ensure solvency for timely and adequate compensation of insured marine risks is 135,789,339.4 naira per annum. The above statistical evidence suggests that maritime accident economic loss grows at a far higher rate than compensation funds reserved by underwriters to maintain financial solvency for timely and adequate compensation of insured risks. This also suggests a dangerous situation, as underwriters may face serious insolvency challenges, given such a situation. From the aforementioned, it is equally evident that the annual rate of change/growth of marine accident economic loss between 2007 and 2016 was higher than the rate of growth of compensation funds reserved by underwriters to maintain financial solvency with regards to timely and adequate compensation of insured risk. The implication is the existence of a problematic situation where marine underwriters in Nigeria are viewed by shippers and maritime operators as lacking financial solvency and adequate capacity for timely and sustainable indemnification of insured marine risks. Maritime operators (shippers and ship-owners), in view of the high value of maritime trade and investments exposed to marine perils and the higher increasing trend of such investment when compared to the lesser value of compensation resources reserved for insured risks and lower annual growth rate of such reserve funds, envisage that underwriters lack capacity and financial solvency to timely and adequately provide compensation for insured risks. Similar studies by the International Monetary Fund (IMF, 2013) also faulted the solvency regime of the Nigerian underwriting sector in general, noting that the basis for the maintenance of technical reserve or reserve funds for the compensation of unexpired risks does not guarantee that underwriters remain financially solvent to ensure timely and adequate compensation of insured risks, when such risks attached.

Unctad (2014) asserts that shipping plays dominant role in the global economy, particularly in the distribution of trade across continents. One may be led to infer that factors that cause a breach in the smooth flow of shipping trade, such as accidents, will certainly create ripple effects on seaborne trade levels, economic growth, and development. This is worse when such factors impose destructive and injurious effects and with no serious management mechanism put in place to force the mitigation of those the effects and to ensure sustainable operations (Zaloshuja et al., 2006). Allianz (2014) reports that, between 2001 to 2011, global losses of ships due to maritime accidents stood at 1,437 ship accidental losses, with the West African region having a sum total loss of 84 vessels, which represents about 5.0 % of global ship accidental losses. Nigeria dominates marine safety issues in the West African Coast, given the size of her coastline, and the volume of seaborne trade and maritime operations (Lame, 2008). CBN (2014) statistics reveal an increasing trend in volumes and values of Nigerian seaborne trade (oil and non-oil trade) from 2006 to 2013. A similar

trend was noted in the performance and output of the marine transport sub-sector, as the contribution of marine transport (GDP<sub>marine transport</sub>) to the gross domestic product (national output) maintained a steady rise from 2006 to 2013 (CBN, 2014). Financial losses occasioned by shipping accidents are found to have a relationship with the productivity of the sector, as well as values and volumes of seaborne import and export trade (Nwokedi et al., 2017; Aderemo, 2012; Robert & Williams, 2007). For example, statistical reports from the CBN (2014) indicate that the value of seaborne import and export trade in Nigeria between 2006 and 2010 was an aggregate of about 50 trillion and 45 trillion naira, respectively, while the GDP contribution of the marine transport sub-sector within the same period was about 6 billion naira. However, the economic cost imposed by shipping accidents compensated by marine underwriters over the same period was an aggregate of 23 billion naira (NIA, 2017). The directions of this relationship are, however, uncertain, as some schools of thought assert that the existence of a relationship does not imply causality, inferring that marine accident induced economic losses may not be causal factors of output decline or improvement in the marine transport subsector (Yan et al., 2013). Allianz, however, recommended compulsory insurance of marine risks, and adequate indemnification and compensation of insured marine risks, as best approaches to ensuring sustainable maritime and shipping operations.

The Allianz (2014) review of global insurance claims for shipping accident loss put global shipping accident loss claims at 45 % of total global loss in all sectors, and offshore O&G drilling accident loss at 12 %, between 2009 and 2013. Statistics by the Nigeria Insurers Association (NIA, 2017) reveal that, between 2006 and 2010, the average shipping accident induced financial losses amounted to 4.620 billion naira per annum. This was exclusive of the cost of safety administration and loss control, environmental impact, legal and police cost, third party cost, and cost of insurance premiums. A report by the International Union of Marine Insurers (IUMI, 2018) put the total financial cost of premiums for purchase of insurance (policy) cover for marine risks between 2006 and 2010 at an average of 14.630 billion naira. The Nigerian Insurers Association (NIA, 2017) also notes the trend of shipping accidents, and the associated quantum of economic loss has implications on the performance of the marine underwriting sector, particularly on the premium for purchase of protection for shipping risks, the claims for compensation in the marine sector, and the output of the marine underwriting sector in terms of the Gross Domestic Product (GDP marine insurance). Statistics by the NIA (2017) and the International Union of Marine Underwriters (IUMU, 2018) indicate that, between 2006 and 2010, an aggregate of 58 billion naira was recorded as the output (GDP) of the marine insurance sub-sector, while about 73 billion naira aggregate was recorded as premium income from insured marine risks by underwriters. The aggregate claims compensated over the same period for shipping accident loss was about 23 billion.

From the foregoing, literature gaps are identified below, in line with the objectives of the study, which the current study seeks to bridge. The problem of financial insolvency of marine underwriters for timely and adequate compensation of insured shipping risks as a result of inadequacy of reserved compensation funds was identified by the IMF (2013), Onuoha (2019), and Nwokoro et al. (2015). However, no empirical study was able to establish how underwriters can overcome this financial insolvency problem, by reserving an adequate volume of compensation funds for insured shipping risks, based on the relationship between actual shipping accident economic losses and the value of seaborne trade exposed to sea perils over a given period, rather than an arbitrary choice of what amounts to a reserve for compensation of unexpired shipping risks. There is a seeming inadequacy of empirical evidence in the available literature on what constitutes the coefficient of elasticity of compensation funds reserved by underwriters for insured shipping risks to growth in shipping accident economic loss in Nigeria. Such knowledge is important for predicting the percentage of changes in funds reserved for insured shipping risks, following increasing trends of shipping accident economic loss, in order that underwriters will maintain adequate financial capacity for timely, adequate, and sustainable indemnification of shipping accident economic risks.

#### 4. Data and methods

This study used the ex-post fact research design, in which time series data was sourced from secondary sources in which data on shipping accident economic loss, value of seaborne trade exposed to marine accidents, and volume of compensation funds maintained by marine underwriters for shipping risks were obtained from the Nigerian Insurers Association (NIA, 2017) and the Central Bank of Nigeria Statistical Report. Each dataset covered a period of 21 years from 1999 to 2019. The descriptive statistics of the dataset are shown in the table below:

**Table 1** Descriptive statistics of the dataset used for the study.

Variable	N	Range (000, naira)	Minimum (000, naira)	Maximum (000, naira)	Mean (000, naira)	Std. Deviation
Volume of compensation funds	21	24,250,569.00	1,826,581.00	26,077,150.00	13,916,407.333	7,463,066.25711
Value of shipping export trade	21	17,844,035,100.0	1,174,964,900.0	19,019,000,000.0	9,306,226,239.5	5,560,597,396.29
Value of shipping import trade	21	16,085,566,800.0	10,433,200.00	16,096,000,000.0	7,517,467,099.5	4,673,692,699.90
Shipping accident economic loss	21	10,052,580.00	440,830.00	10,493,410.00	2,517,007.8571	2,754,278.4684
Valid N (listwise)	21					

Sources: Central Bank of Nigeria Statistical Bulletin (ii) Nigerian Insurers Association (NIA)

Both multiple and simple regression methods were used to analyze the data obtained. The log-linear simple and multiple regression methods were used to estimate the elasticity coefficients of shipping accident economic loss occasioned in increasing volume and value of seaborne import and export trade. The first objective of the study sought to determine the elasticity of relationships between shipping accident economic loss and the value of seaborne trade (import and export shipping trade) as a basis for developing empirical conditions for timely, adequate, and sustainable compensation of marine accident economic loss in Nigeria; a log-log constant elasticity model based on the multiple regression analysis was used to estimate the elasticity. The second part of the objective was to determine the elasticity of the relationship between shipping accident economic loss and compensation funds reserved for insured shipping risks over the period, which was also achieved using a log-log constant elasticity model based on a simple regression method. The model specification is shown below:

For purposes of determining the elasticity of the relationships, two approaches were obtainable, which include the use of the average coefficient of elasticity ( $E$ ) model to estimate the level of changes in shipping accident economic loss as a result of changes/growth in the value of shipping export and import trade exposed to the perils of the sea; and the use of the constant elasticity model/double-log-linear model. We defined the coefficient of elasticity mathematically as the ratio of percentage changes in quantum of shipping trade (seaborne export and import trade) to percentage changes in shipping accident economic loss. The model specification of OLS multiple regression for the estimation of the significance of the relationship was:

$$SHALT = \beta_0 + \beta_1 EXPSTRADEt + \beta_2 IMPSTRADEt + \varepsilon t \quad (1)$$

Eq. (1) was used to estimate the first objective of the study, using the ordinary least square (OLS) method.

The second objective of the study, which was to estimate the coefficient of elasticity of shipping accident economic loss to changes in the value of shipping import and export trade in Nigeria, was determined using the double-log-linear (constant elasticity) model, stated as:

$$\ln SHAL_t = \beta_0 + \beta_1 \ln EXPSTRADE_t + \beta_2 \ln IMPSTRADE_t + \varepsilon_t \quad (2)$$

In the above double-log models, both coefficients of regression  $\beta_1$  and  $\beta_2$  estimate the elasticity of shipping accident economic loss to percentage changes in the values of shipping export and import trade over the period (Gujarati & Porter, 2009).

The average coefficient of elasticity model may also be used as follows:

where:

$SHAL_t$  = mean shipping accident economic loss over the period covered in the study

$IMPSTRADE_t$  = mean seaborne import trade over the period

$\Delta IMPSTRADE_t$  = change in value of seaborne import trade

$\Delta SHAL_t$  = change in shipping accident economic loss

$\beta_1$  = coefficient of the explanatory variable (export trade)

$E_{is} = \beta_1$  coefficient of elasticity of shipping accident economic loss to changes in value of seaborne export trade

$E_{es} = \beta_2$  coefficient of elasticity of shipping accident economic loss to changes in value of seaborne import trade

$\beta_0$  = regression constant

$\Delta EXPSTRADE_t$  = level changes in value seaborne export trade over the period

$EXPSTRADE_t$  = mean seaborne export trade over the period

However, double-log model (constant elasticity model) was used in the study to estimate the elasticity coefficients in using Eq. (2) (Gujarati & Porter, 2009).

To achieve the third objective of the study, aimed at determining the coefficient of elasticity of compensation funds maintained for insured shipping risks to changes in shipping accident economic loss over the period, we employed the log-linear (constant elasticity) model, specified as shown in Eq. (3):

$$\ln MAPRE_t = \beta_0 + \beta_1 \ln SHAL_t + \varepsilon_t \quad (3)$$

where:

$\beta_1$  = elasticity coefficients (Gujarati & Porter, 2009).

Using the constant elasticity model/double-log linear model, we established the coefficients of elasticity of compensation funds ( $MAPRE$ ) maintained for insured shipping accident risks to changes in the shipping accident economic loss over the period. Also note that:

If  $E < |1|$  → inelastic response

If  $E > |1|$  → elastic

If  $E = |1|$  → unit elastic

## 5. Results and discussion

We estimated the relationship between shipping accident economic loss and seaborne trade using Eq. (1), as shown in **Table 1** below.

**Table 2** above was determined using Eq. (1). The results show that the mean value of shipping import trade exposed to accidents per annum over the period covered in the study was 7,779,420,252,105.26 naira, with a standard deviation of 455,096,386,733.5, while the mean value of shipping export trade exposed to sea perils per annum over the same period was 9,306,226,239.52 naira, with standard deviation of 5,560,597,396.28. The mean shipping accident economic loss per annum over the period was 2,163,028,202.316, with standard deviation of

2,162,210,840.14. By implication, an average of 2,163,028,202.316 naira was lost per annum by the economy due to shipping accidents affecting shippers and ship-owners as a result of exposure to perils of the sea over the period. The mathematical model showing the relationship between shipping accident economic loss and the growth in the seaborne import and export trade over the period covered in the study is Eq. (4):

$$SHAL_t = 2430145.277 + 0.34IMPSTRADE_t + 0.051EXPSTRADE_t + e \quad (4)$$

**Table 2** Formulating a model of the relationship between shipping accident economic loss and growth in seaborne trade in Nigeria.

Test-statistic	Coefficient(s)
Mean in dependent variable $IMPSTRADE_t$	7,779,420,252,105.26
Mean independent variable $EXPSTRADE_t$	9,306,226,239.52
Mean dependent variable $SHAL_t$	2,163,028,202.3158
Regression coefficient $\beta_1$	0.343
Regression coefficient $\beta_2$	0.051
Regression constant $\beta_0$	2,430,145.277
Standard error of regression	1,188,521.584
R-square	0.691
F-statistic	4.945
Prob(F-statistic)	0.061
F-critical	3.71
T-statistics	
Parameter(s)	Coefficient(s)
t-score ( $\beta_1$ )	1.913
t-score ( $\beta_2$ )	1.904
P-value(s)	
	0.072
	0.073

Source: SPSS output.

By implication, for a unit increase/change in shipping import trade, shipping accident economic loss increased by an average of 0.34, while a unit increase in seaborne export trade increased shipping accident economic loss by 0.051 units. The coefficient of determination R-square, which measures the explanatory power of the model, was 0.69. This shows that about 69 % variation in shipping accidents economic loss over the period is explained by changes in the values of seaborne import and export trade exposed to sea perils over the period. The significance of the relationship is tested under the test of hypotheses in the subsequent section. However, a major importance of the above relationship between shipping accident economic loss and growth in the shipping import and export trade exposed to sea perils over the period is that it offers the needed basis for the estimation of the coefficients of elasticity of shipping accident economic loss to changes/growth in the shipping import and export trade. The coefficients of elasticity, once determined, enable us to develop empirical conditions that guarantees that compensation funds reserved for unexpired insured shipping risks can enable marine underwriters to maintain financial solvency for timely, adequate, and sustainable compensation of shipping accident economic loss in Nigeria. The estimation of the coefficients of elasticity is discussed below in **Table 3**.

**Table 3** above was determined using Eq. (2). The results indicate that the coefficients of elasticity of shipping accident economic loss to growth/changes in the seaborne import trade over the period is 0.27. This indicates an inelastic relationship between shipping accident economic loss and growth in the seaborne import trade over the period, since  $0.27 < 1$ . By implication, a 1%

growth (change) in seaborne import trade over the period produces an average of 0.27 % increase in shipping accident economic loss. The policy implication for marine underwriters, shippers, and shipping policy formulators is that increasing seaborne import trade over a given period of time holds the potential to increase shipping accident economic loss by a 1 to 0.27 % relation; implying that, for every 1 % increase in seaborne import trade, compensation funds maintained for insured shipping import trade must increase by about 0.27 %, in order that underwriters can maintain the right level of financial solvency needed to ensure timely, adequate, and sustainable compensation of insured shipping risks. Marine insurance policies can, thus, be proactively designed to make provision for adequate reservation of compensation funds proportionate to the level of increase in shipping accident economic loss induced by increasing value of seaborne import trade. Therefore, compensation funds for settling shipping accidents economic risk should increase with increasing seaborne import trade value. The increase in compensation funds for shipping accident economic loss, in order to adequately settle claims within the given period, must be greater than or equal to 0.27 % of the mean or preceding year value of shipping accident economic loss.

**Table 3** Coefficients of elasticity of shipping accident economic loss to growth in shipping import and export trade.

Variable	Coefficients(s)
<b>Test-statistics</b>	
Mean dependent variable $InSHAL_t$	14.2938
Regression constant	7.716
Mean dependent variable $InIMPSTRADE_t$	22.2189
Mean independent variable $InEXPSTRADE_t$	22.6837
Elasticity coefficient $\beta_1 = E_{is}$	0.274
Elasticity coefficients of elasticity $\beta_2 = E_{es}$	0.585
R-square coefficient	0.563
F-statistic	3.511
F-critical	2.71

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

Similarly, the coefficient of elasticity of shipping accident economic loss to growth/changes in the value of seaborne export trade ( $E_{es}$ ) over the period is 0.56. This also shows the existence of an inelastic relationship between shipping accident economic loss and the seaborne export trade over the period. However, it indicates that a percentage (1 %) growth in the value of seaborne export trade over the period covered in the study produced a 0.56 % increase in shipping accident economic loss. By implication, as value of seaborne export trade increases by 1 %, shipping accident economic loss increases by 0.56 %. Therefore, to ensure that marine underwriters remain financially solvent, and ensure timely and adequate compensation of insured shipping export risks, compensation funds for insured shipping export risks must increase by a figure equal to or greater than 0.56 % of the mean value or preceding year value of shipping accident economic loss for each percentage increase in value of seaborne export trade.

In summary, we conclude that, though a significant relationship exists between shipping accident economic loss and growth in shipping import and export trade, there is, however, an inelastic relationship between shipping accident economic loss and growth in shipping import and export trade over the period.

The result is in line with the findings of the IMF (2013) and Nwokoro and Nwokedi (2015), that the solvency regime of marine underwriters cannot guarantee adequate, timely, and sustainable

compensation of insured risks when such risks are attached. This situation constitutes the continued motivation of local operators in the maritime industry to seek for alternative ways of securing timely, adequate, and sustainable protection of seaborne investments with foreign P&I clubs to the disadvantage of the local economy. The inelastic nature of the relationship of shipping accident economic loss to growth in shipping trade cannot favorably guarantee timely, adequate, and sustainable indemnification of insured marine accident risks in the long run.

However, this provides information for developing empirical conditions and relationships that will ensure that marine underwriters maintain financial solvency to guarantee timely, adequate, and sustainable compensation of insured shipping and marine accident risks. Based on the respective coefficients of elasticity of shipping accident economic loss to growth in seaborne import and export trade, we deduced empirical conditions that marine underwriters must abide with, in order to remain financially solvent by maintaining sufficient volumes of reserve funds, for each class of insured shipping trade, to ensure timely, adequate, and sustainable compensation of insured shipping risks. These conditions are shown in **Table 4** below.

**Table 4** Empirical conditions for reservation of adequate volume of funds to ensure underwriters' financial solvency and the timely, adequate, and sustainable compensation of shipping accident economic loss affecting shipping import and export trade in Nigeria.

s/n	Variable	Elastic relations between variables	Policy effect and implication for financial solvency and timely, adequate, and sustainable compensation of insured shipping risks	Remarks
1	$IMPSTRADE$	1 % increase	For each 1 % increase in value of import shipping trade:	X % Increase in $IMPSTRADE$ when $X > 1$ will lead to $X(0.274\%)$ increase in $SHAL_t$ . $\Delta MAPRE \geq X(0.274\%)$ of mean $SHAL_t$ or preceding year value $Y_s$ , whichever is greater.
	$SHAL_t$	0.274 % increase	Increase/ $\Delta MAPRE \geq 0.274\%$ of mean value of $SHAL_t$ ; or $\Delta MAPRE \geq 0.274\%$ of preceding year value ( $Y_s$ ) of $SHAL_t$ [when $Y_s >$ mean value of $SHAL_t$ ]	
2	$EXPSTRADE$	1 % increase	For each 1 % increase in export:	X % Increase in $EXPSTRADE$ when $X > 1$ will lead to $X(0.585\%)$ increase in $SHAL_t$ . $\Delta MAPRE \geq X(0.585\%)$ of mean $SHAL_t$ or preceding year value $Y_s$ , whichever is greater.
	$SHAL_t$	0.558 % increase	Increase/ $\Delta MAPRE \geq 0.585\%$ of mean value of $SHAL_t$ ; or $\Delta MAPRE \geq 0.585\%$ of preceding year value ( $Y_s$ ) of $SHAL_t$ [when $Y_s >$ mean value of $SHAL_t$ ]	

Source: Author's calculation.

The implication is that, for underwriters to maintain financial solvency and ensure timely and adequate compensation of insured shipping risks, compensation funds (MAPRE) maintained for compensation of shipping import and export trade must increase proportionately by amounts equal to or greater than the respective coefficients of elasticity of shipping accident economic loss to growth in seaborne trade. For a percentage (1 %) increase in shipping import trade, an increase in compensation funds reserved by underwriters ( $\Delta MAPRE$ ) must be greater than or equal to 0.274 % ( $\Delta MAPRE \geq 0.274\%$ ) of mean value of shipping accident economic loss over the period ( $SHAL_t$ ); or where the preceding year value ( $Y_s$ ) of  $SHAL_t$  is greater than the mean value, an increase in compensation funds reserved by underwriters must be greater than or equal to 0.274 % ( $\Delta MAPRE \geq 0.274\%$ ) of the preceding year value of shipping accident economic loss ( $Y_s$ ).

For a percentage (1 %) increase in shipping export trade, an increase in compensation funds reserved by underwriters for shipping export trade ( $\Delta MAPRE$ ) must be greater than or equal to 0.585 % ( $\Delta MAPRE \geq 0.585\%$ ) of mean value of shipping accident economic loss over the period ( $SHAL_t$ ); or where the preceding year value ( $Y_s$ ) of  $SHAL_t$  is greater than the mean value, an

increase in compensation funds reserved by underwriters must be greater or equal to 0.585 % ( $\Delta MAPRE \geq 0.585\%$ ) of the preceding year value of shipping accident economic loss ( $Y_s$ ).

**Table 5** below shows the results of the elasticity coefficient of compensation funds for shipping accident risks to changes in shipping accident economic loss between 1999 and 2019.

**Table 5** Coefficient of elasticity of compensation funds for shipping risks to growth in value of shipping accident economic loss in Nigeria.

Test-statistic	Coefficient(s)
Mean dependent variable $InSHAL_t$	16.2239
Mean $InMAPRE_t$	14.2938
Mean $MAPRE_t$	13,829,427,285.71
Mean $SHAL_t$	2,163,028,202.3158
Regression coefficient $\beta_1 = E_{rs}$	0.364
Regression constant $\beta_0$	11.021
Standard error of regression	2.568
R-square	0.562
T-score	2.030
Prob(t-statistic)	0.0537
t-tabulated	1.71

Source: SPSS output. Note: if  $E < 1 = \text{inelastic.}$ ; if  $E \geq 1 = \text{elastic relationship.}$

**Table 5** above was determined using Eq. (3). The results show that the coefficient of elasticity of compensation funds maintained for insured shipping risks to growth in shipping accident economic loss over the period is 0.364. The relationship is, however, inelastic, since  $0.364 < 1$ . This indicates that the response of marine underwriters in reservation of compensation funds for insured shipping risks to the growing trend of shipping accident economic loss over the period is inelastic. This does not grow proportionately in line with growth in the trend of shipping accident economic loss. The equation showing the relationship between compensation funds reserved for insured shipping risks to increasing shipping accident economic loss over the period is Eq. (5):

$$InMAPRE_t = 11.021 + 0.364InSHAL_t + e \quad (5)$$

The t-score is 2.030 and t-tabulated is 1.71. Since t-score > t-tabulated (i.e.,  $2.030 > 1.71$ ); we infer that there is a significant relationship between the compensation funds maintained for insured shipping risks and the value of shipping accident economic loss over the period. The results also show that the average volume of funds maintained by underwriters for compensation of shipping risks per annum over the period covered in the study was 13,829,427,285.71 naira, with a standard deviation of 7,620,009,105.5, while the average amount lost due to shipping accidents per annum over the same period amounted to 2,163,028,202.3158, with a standard deviation of 2,754,278,441.28.

The coefficient of elasticity of compensation funds for shipping risks to growth in shipping accident economic loss of 0.364 implies that a 1 % increase in shipping accident economic loss produced a 0.364 % increase in reserved funds for compensation of insured shipping risks maintained by marine underwriters over the period. By implication, compensation funds for indemnifying shipping accident economic loss does not increase proportionately with or above the shipping accident economic loss rate of increase. This endangers the capacity of marine

underwriters to maintain financial solvency for timely and adequate indemnification of insured shipping risks. This finding is in line with those the IMF (2013) and Nwokoro et al. (2015). This problem of financial insolvency is the reason for the fear and lack of trust in the operations of local marine underwriters of ship-owners and shippers. To ensure that underwriters maintain financial solvency to ensure timely, adequate, and sustainable indemnification of shipping accident economic loss, compensation funds for shipping accident risks must be made to increase at a rate greater than or proportional to 1 % of the mean or the previous year value of shipping accident economic loss, for every 1 % increase in shipping accident economic loss in Nigeria. See **Table 6** below for the empirical conditions that guarantee that adequate funds are reserved for the sustainable compensation of insured shipping risks in Nigeria.

**Table 6** Empirical conditions that sufficiently ensures underwriters' financial solvency for timely, adequate, and sustainable compensation of insured shipping risks based on the coefficients of elasticity of compensation funds reserved for shipping risks to growth in shipping accident economic loss in Nigeria.

s/n	Variable	Mean	Elastic relations between variables	Effect and policy implication for solvency and timely, adequate, and sustainable compensation of insured marine risks	Remarks
1	$SHAL_t$	2,163,028,202.32	1 % increase	For each 1 % increase in $SHAL_t$ :	X % change in $SHAL_t$ when $X > 1$ ;
	$MAPRE_t$	13,829,427,285.71	0.364 % increase	Increase/ $\Delta MAPRE \geq 1\%$ of mean $SHAL_t$ or $\Delta MAPRE \geq$ Preceding year value of $SHAL_t$ ( $Y_s$ ), when $Y_s >$ mean $SHAL_t$	increase/ $\Delta MAPRE \geq X\%$ of mean $SHAL_t$ Or $\Delta MAPRE \geq X\%$ of preceding year value of $SHAL_t$ ( $Y_s$ ), where $Y_s >$ mean $SHAL_t$

Source: Author's calculation.

The implication of the above conditions for policy development in the marine insurance sector is that, for a percentage (1 %) increase in shipping accident economic loss, an increase in compensation funds reserved by underwriters for indemnifying shipping accident economic loss ( $\Delta MAPRE$ ) must be greater than or equal to 1 % ( $\Delta MARE \geq 1\%$ ) of mean value of shipping accidents economic loss over the period ( $SHAL_t$ ); or where the preceding year value ( $Y_s$ ) of  $SHAL_t$  is greater than the mean value, increase in compensation funds reserved by underwriters for indemnification of shipping accident economic loss must be greater than or equal 1 % ( $\Delta MAPRE \geq 1\%$ ) of the preceding year value of shipping accident economic loss ( $Y_s$ ).

## 6. Policy implications

### 6.1 Policy implications of the relationship between shipping accident economic loss and the value of seaborne trade exposed to sea perils in the reservation of funds for compensation of insured shipping risks in Nigeria

The existence of a significant relationship between shipping accident economic loss and growth in maritime trade in Nigeria provides support for the development of empirical conditions to ensure that shipping accident economic loss is adequately, timely, and sustainably indemnified in order to ensure sustainable seaborne trade and shipping operations. This is because, given the

increasing trend of shipping accident economic consequences, failure to adequately indemnify it will in the long run crash shipping trade and maritime investments, and put operators out of business. However, to ensure adequate indemnification, marine underwriters must have financial solvency to do so, and have a reservation of volume of funds that is proportionate to, or higher than, actual shipping accident economic consequences. The coefficient of elasticity of shipping accident economic loss to growth in value of shipping trade of 0.27 determined in the study provides the empirical information to enable underwriters to reserve adequate volumes of funds in line with increases in the value of maritime trade and shipping accident economic consequences. Though the elasticity coefficient of 0.27 indicates an inelastic response of shipping accident economic loss to growth in value of seaborne import trade exposed to sea perils, the significant relationship between them suggests that ensuring adequate compensation for shipping accident economic consequences cannot be ignored for seaborne trade to be sustainable. By implication, a 1 % growth (change) in seaborne import trade over the period produces an average of 0.27 % increase in shipping accident economic loss.

The policy implication for marine underwriters, shippers, and shipping policy formulators is that increasing seaborne import trade over a given period of time holds the potential to increase shipping accident economic loss by a 1 to 0.27 % relation, implying that, for every 1 % increase in seaborne import trade, compensation funds for insured shipping import trade must increase by about 0.27 % of the preceding year value of shipping accident economic loss or the average value, in order that underwriters can reserve the right level of funds and maintain the financial solvency needed to ensure timely, adequate, and sustainable compensation of insured shipping risks. Marine insurance policies can, thus, be proactively designed to make provision for the adequate reservation of compensation funds, by increasing compensation funds reserved for indemnification of insured shipping risks proportionately in line with the level of increase in shipping accident economic loss induced by growing seaborne import trade. Therefore, compensation funds for settling shipping accident economic risk should increase with increasing seaborne import trade. The increase in compensation funds for shipping accident economic loss in order to adequately settle claims within the given period must be greater than or equal to 0.27 % of the mean or the preceding year value of shipping accident economic loss.

Similarly, the coefficient of elasticity of shipping accident economic loss to growth in the value of seaborne export trade ( $E_{es}$ ) over the period is 0.56. This is also inelastic. However, this indicates that a percentage (1 %) growth in the value of seaborne export trade produces a 0.56 % increase in shipping accident economic loss. By implication, as the value of seaborne export trade increases by 1 %, shipping accident economic loss increases by 0.56 %. Therefore, to ensure that marine underwriters remain financially solvent and to ensure timely and adequate compensation of insured shipping export risks, compensation funds for insured shipping export risks must increase by a figure equal to or greater than 0.56 % of the mean value or the preceding year value of shipping accident economic loss, for each percentage increase in value seaborne export trade. Therefore, to overcome the financial insolvency faced by underwriters in the compensation of insured shipping risks identified by the IMF (2013) and Nwokoro et al. (2015), consequent from the arbitrary provisions of the Insurance Act 2007, for reservation of between 25 to 45 % of marine premium income as compensation funds for unexpired risks, the respective coefficients of elasticity of shipping accident economic loss to growth in values of seaborne import and exports of 0.27 and 0.56 % offers the empirical values by which compensation funds for insured shipping import and export trade should be increased, using the average or preceding year values of shipping accident economic loss as a basis.

## **6.2 Policy implications of the coefficient of elasticity of compensation funds available for insured shipping risks to growth in shipping accident economic loss in Nigeria**

The study also found the existence of a significant relationship between compensation funds reserved for the indemnification of insured shipping risks and shipping accident economic loss in Nigeria over the period. It found that the coefficient of elasticity of compensation funds maintained for insured shipping risks to growth in shipping accident economic loss was 0.364, indicating an inelastic response of marine underwriters in the reservation of compensation funds for shipping risks following the growing trend of shipping accident economic loss over the period. This shows that compensation funds for insured shipping risks did not grow proportionately in line with the growth in shipping accident economic loss. This corroborates the findings of the IMF (2013) and Nwokoro et al. (2015).

The coefficient of elasticity of compensation funds for shipping risks to growth in shipping accident economic loss of 0.364 implies that, with a 1 % increase in shipping accident economic loss, underwriters only increased compensation funds reserved for the indemnification of insured shipping risks by 0.364 % over the period. By implication, compensation funds for indemnifying shipping accident economic loss does not increase proportionately with or above the shipping accident economic loss rate of increase. This endangers the capacity of marine underwriters to ensure sustainably maintained financial solvency for the timely and adequate indemnification of insured shipping risks. This finding is in line with those of the IMF (2013) and Nwokoro et al. (2015). This problem of financial insolvency is the reason for the fear and lack of trust in the operations of local marine underwriters of ship-owners and shippers (Onuoha, 2019; Adegbayi, 2017). To ensure that underwriters maintain financial solvency to provide timely, adequate, and sustainable indemnification of shipping accident economic loss, compensation funds for insured shipping risks must be made to increase at a rate greater than or proportional to 1 % of the mean or previous year value of shipping accident economic loss for every 1 % increase in shipping accident economic loss in Nigeria.

## **7. Conclusions**

This study has been able to investigate, for the first time, the coefficients of elasticity of shipping economic loss to the growth in shipping trade and the elasticity of compensation funds maintained by underwriters for insured marine risks to changes in shipping accident economic loss covering the period 1999 – 2019, as a basis for developing empirical relationships to ensure the financial solvency of marine underwriters for the timely, adequate, and sustainable compensation of shipping accident economic loss in Nigeria. It was found that a significant relationship existed between shipping accident economic loss and the growth in shipping import and export trade. It also found that, for every 1 % growth in seaborne import trade, shipping accident economic loss increased by 0.274 %, while it increased by 0.558 % for every 1 % growth in seaborne export trade. The coefficient of elasticity of compensation funds for insured shipping risks to changes in shipping accident economic loss over the period was 0.364. This implies that, for each 1 % increase (change) in shipping accident economic loss, compensation funds maintained for shipping accident economic risks increased by 0.364 %. The coefficients elasticity was determined, based on which the empirical conditions for the reservation of funds for the timely, adequate, and sustainable compensation of insured shipping risks were developed.

## **8. Recommendations**

1. Regulators of the marine underwriting sector should ensure that the empirical relationships between shipping accident economic cost and the corresponding compensation funds maintained for each class of shipping trade form the basis for developing policies for the reservation of compensation funds for shipping accident economic loss. This will guarantee adequate and sustainable indemnification of insured losses in the long run. The arbitrary reservation of between

25 to 45 % of premium income from each class of insured marine risks by underwriters without recourse to the history and quantum economic loss and value of maritime trade insured is wrong, and should be discouraged.

2. With growth/increase in the shipping import and export trade, underwriters should expect increase in the value of shipping accident economic loss, though not proportionately with growth in shipping trade. Thus, it is recommended that underwriters increase financial resources reserved for compensation of shipping accident economic loss proportionately and in line with the quantum of increase in economic loss.

## 9. Limitations of the study

The data used in the modeling was sourced from the Central Bank of Nigeria (CBN), the Nigeria Insurance Digest (NIA), and the IUMU. As a result, the accuracy of the findings will, to a large extent, be influenced by the accuracy of the data used for the study.

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