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EXPLORING THE GEOPOLITICAL IMPACT ON THE TRANSPORTATION COST OF CONTAINERS

PAPATHEOFILOU ANASTASIA MARIA

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This Diploma Thesis was unanimously approved and graded by this M.Sc in Shipping Management' Thesis Defense committee as typically appointed by the relevant authorities of the Department of Maritime Studies, University of Piraeus.

The Members of the Defense Committee are:

- Tsioumas Evangelos (Supervisor)
- Polemis Dionysios
- Stavroulakis Petros

The approval of this Thesis by the Department of Maritime Studies, University of Piraeus does not imply in any way endorsement of the author's opinions.

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ABSTRACT

The international shipping industry is critical to global trade, yet it remains highly sensitive to geopolitical factors that can disrupt supply chains, impact container trade, and drive up costs. This study investigates the dual impact of geopolitical events on supply chain and the container trade and how the crisis in Red Sea affects the transportation cost of containers. By reviewing geopolitical risks, including political instability and international conflicts, the analysis highlights how these factors lead to increased freight rates, supply chain disruption, and environmental footprint. A questionnaire targeting industry professionals provided insights into risk perception and adaptive strategies. The findings underscore the factors influencing freight rates, driven by both geopolitical and economic variables, and reveal the wider impact of geopolitical disruptions on global logistics. This study emphasizes the need for strategic adaptations in a volatile global environment.

Key Words: container trade, geopolitical risk, crisis in Red Sea, freight rates

ΠΕΡΙΛΗΨΗ

Η διεθνής ναυτιλιακή βιομηχανία είναι κρίσιμη για το παγκόσμιο εμπόριο, αλλά παραμένει ιδιαίτερα ευαίσθητη σε γεωπολιτικούς παράγοντες που μπορούν να διαταράξουν τις αλυσίδες εφοδιασμού, να επηρεάσουν το εμπόριο εμπορευματοκιβωτίων και να αυξήσουν τα κόστη. Η μελέτη αυτή διερευνά τον αντίκτυπο γεωπολιτικών γεγονότων στις αλυσίδες εφοδιασμού και στο εμπόριο εμπορευματοκιβωτίων, καθώς και την επίδραση της κρίσης στην Ερυθρά Θάλασσα στο κόστος μεταφοράς. Μέσα από την ανάλυση γεωπολιτικών κινδύνων, όπως πολιτική αστάθεια και διεθνείς συγκρούσεις, καταδεικνύεται η αύξηση των ναύλων, η διατάραξη της εφοδιαστικής αλυσίδας και η περιβαλλοντική επιβάρυνση. Ένα ερωτηματολόγιο το οποίο απευθυνόταν σε επαγγελματίες του κλάδου παρείχε στοιχεία για την αντίληψη του κινδύνου και τις στρατηγικές προσαρμογής. Τα αποτελέσματα αναδεικνύουν τους παράγοντες που επηρεάζουν τα ναύλα και τον ευρύτερο αντίκτυπο των γεωπολιτικών διαταραχών στην παγκόσμια εφοδιαστική αλυσίδα.

Λέξεις κλειδιά: εμπόριο εμπορευματοκιβωτίων, γεωπολιτικό ρίσκο, κρίση στην Ερυθρά θάλασσα, αγορά ναύλων

2. INTRODUCTION

The international shipping sector plays a pivotal role in the flow of goods across borders. Since world trade is based on this industry, freight rates become a mean that affects and is affected by the economy and the stability of geopolitics. Numerous variables shape the transportation cost of tradable products. Among these, geopolitical factors directly influence the development of maritime commerce.

The purpose of this diploma thesis is double; firstly to highlight how the geopolitical factors affect the supply chain and the container trade, and secondly to show how the increased risk in the Red Sea affects the transportation cost of containers.

Nowadays, globalization has led to the growth of trade between countries all around the world. In case a geopolitical risk arises, the whole trade and economy will be affected. The term geopolitics encompasses a variety of different phenomena such as political instability, wars, tensions, and military conflicts between countries that can have regional or global impacts. These type of events disrupt freight markets by causing supply chain delays, increasing transportation costs due to fuel price spikes, and introducing higher risks and insurance premiums. Ports and trade routes may close, leading to rerouting and longer transit times. These factors drive up shipping rates and reduce market stability. The global economy can be affected by geopolitical events both directly and indirectly through financial, trade and commodity price channels. It influences the course of international relations and therefore alterations in logistics are inevitable. The increased geopolitical risk will also differentiate the customs clearance procedure and the border management as well.

Container freight rates are influenced by economic fundamentals and geopolitical factors, with both affecting supply chain stability and costs. Fuel prices, for instance, directly impact shipping expenses, while economic booms drive up demand, raising rates, whereas downturns lead to excess capacity and rate decreases. Supply-demand dynamics remain central: high demand and limited vessel availability cause rate spikes, while overcapacity has the opposite effect. Exchange rates also play a role, as freight contracts are often in USD, influencing profitability when exchange rates fluctuate. Supply chain efficiency impacts rates through port congestion, container shortages, and

labor issues, which reduce capacity and elevate costs, though technological advancements can help stabilize rates by boosting efficiency. Together, these economic and geopolitical factors create a complex and often unpredictable freight market.

Furthermore, supply chain disruptions usually lead companies to look for alternate shipping routes or forms of transportation to avoid impacted areas as a result of supply chain interruptions. This shift in demand will not only cause competition and congestion for available capacity but will also increase freight rates. The management of inventories is a significant issue. Another factor that can shape freight rates is the reaction to disturbances in the supply chain. Businesses can modify their inventory management procedures by holding larger safety stocks or switching suppliers. These modifications may have an impact on shipping volumes and patterns and consequently on freight rates.(Finck, & Tillmann, 2022)

This study aims not only to show how the geopolitical risk affect the freight market in general, but also how the crisis in Red affects the container cost. Current bibliography provides an image of the impact of geopolitical risks in the freight market, but further analysis and explanation is required. In addition to this, there are not a lot of research scientific articles and reports regarding the effect that the crisis in Red sea has in the container trade. Given that the Red Sea crisis is ongoing at the time of writing, this analysis concentrates mainly on the initial impacts of the crisis on the shipping industry and global supply chains. A comprehensive understanding of the full consequences will only be possible once the situation has either concluded or stabilized, reducing the current levels of uncertainty and risk affecting shipping and trade to a more manageable level.

To gain a comprehensive understanding of how industry professionals perceive and respond to the challenges posed by geopolitical risks, a questionnaire was developed. This tool aims to capture insights directly from individuals working within the market, providing a clearer picture of their perspectives and strategies for managing such risks.

Having established the broader context of geopolitical risk impacts in the freight market and the overview of professionals' opinions, this study aims to highlight how geopolitical factors influence the supply chain and container trade and how the increased risk in the Red Sea impacts the transportation cost of containers.

LITERATURE REVIEW

3. GEOPOLITICAL FACTORS

The global trade industry relies on the coordination and cooperation of multiple countries to maintain a smooth flow in supply chains. As described in the article of Lotus Containers (2024), each nation benefits economically from import and export activities, which collectively contribute to the growth of the global economy. Given the substantial investments that countries have made in trade, any political tensions can disrupt the entire supply chain. Such disruptions pose a threat to the financial stability of nations involved. These geopolitical events can arise from various causes, impacting trade and the broader economic landscape.

The term "geopolitical factors" in shipping refers to the different geographic and political forces that have an impact on international commerce routes, marine security, and cargo transportation. The shipping industry is particularly vulnerable to geopolitical changes because of the potential for political unrest in important trading regions, armed conflicts, and disruptions to shipping routes and global supply chains (Theodorou, 2024). Geopolitical factors play a significant role in shaping the dynamics of the shipping industry, as they can directly influence trade routes, shipping costs, and overall market stability. Political instability, conflicts, sanctions, and territorial disputes can disrupt established supply chains, forcing vessels to reroute, which often results in longer transit times and higher fuel consumption.

Additionally, changes in trade policies or the imposition of tariffs can shift trade patterns, impacting the demand for shipping services in specific regions. Geopolitical tensions can also lead to increased insurance premiums for vessels navigating high-risk areas, further elevating operational costs. Port closures or restrictions due to geopolitical conflicts can cause delays and congestion, affecting the reliability of maritime transport (Yap & Yang , 2024). Consequently, the shipping industry must remain adaptable to geopolitical developments, as they can have far-reaching consequences on global trade and logistics. Below, some of the most important factors are analyzed.

3A. POLITICAL FACTORS AND INTERNATIONAL RELATIONS

Uncertainty usually increases sharply after significant policy and economic shocks. Growing economic and policy uncertainty create a turbulent environment for the marine industry and international trade. International political and economic uncertainty may have a major direct and indirect impact on the maritime sector. Consistency in trade agreements and practices is generally associated with political stability. Trade agreements that lower tariffs and other trade obstacles are more likely to be established by stable governments.

Political instability is a natural tendency of a government to collapse either because of conflicts or growing struggles, sometimes violent, between various political parties. Political instability also occurs if there is a rapid change of government and policy, increasing the likelihood of subsequent instability. Economic growth and political stability are also deeply interconnected. A nation's investment levels and the rate of its economic development may be impacted by the uncertainty that accompanies an unstable political climate. Furthermore, political instability and the fall of governments can result from weak economic performance. These circumstances are a recurring and important factor in the political unrest that exists globally (AG Global Strategies, 2024). Carmignani (2003) highlited that political instability is portrayed in theoretical literature as a constraint that modifies a critical element (such as the time horizon or the set of information available) in the decision-making process of policymakers and/or private agents in economic models. As a result, real judgements and policies may not always align with the first-best or optimal ones.

Y.H. Venus Lun, Kee-hung Lai and T.C.E. Cheng (2011) have conducted an analysis based on data from 57 countries collected in BMI's freight transport report (BMI 2008). The purpose of this analysis was to show the determinants of freight transport that are economic risk, political risk, transport infrastructure growth, regulatory environment, competitive environment, and transport complex economy. They concluded that political risk is negatively associated with freight transport. The higher the political risk, the less growth for freight transport volume. However, the environment in which businesses operate is positively associated with political risk.

The application of trade policies has a major role in determining the presence of consistent and reliable market access. Agreements made under the World Trade Organisation (WTO) should aim to make trade and investment conditions more predictable to reduce political risk. Domestic rules, regulations, and practices must be transparent to ensure predictable trading. Therefore, it is crucial that WTO agreements include rules about transparency, requiring disclosure through formal documentation at the national or international level. Promoting transparency at the national and international levels is essential for mitigating political risk and promoting the expansion of freight transportation. (Y.H. Venus Lun*, et al., 2011).

Moreover, political actions that affect oil production will have an impact on crude oil prices (e.g., U.S. sanctions on Venezuela), which can affect shipping costs. Sanctions aimed against shipping lines or financial activities may limit access to vital marine services, insurance choices, and payment methods. These limitations may increase operating expenses, which would raise freight costs (EL-MASRY, et al., 2010).

The profit margins of maritime companies can be eroded due to geopolitical risks. More specifically, in order to deal with those risks and minimize the possible threat, shipping companies take extra security measures and pay insurance premiums. These increased costs are added to the operational expenses of the vessel, reducing the profit margins. Market volatility brought on by political unrest can result in unstable pricing and demand for shipping services. In the long term, it can affect investment and planning.

As shown in the research of Karklina S. et al. (2024), measures aimed at facilitating international trade are frequently closely related to the responsibilities of customs authorities. From the standpoint of the global supply chain, customs is one of the major actors in trade facilitation. Because of this, nearly all national customs administrations have to make sure that border customs regulations and the facilitation of legitimate trade are balanced. Both customs and border control are undergoing major alterations. These alterations are a result of the geopolitical events, the increasing flow of goods and new technology. Modifications to border controls, inspection protocols, and customs rules, which are frequently impacted by political decisions, have the potential to accelerate or impede the movement of commodities. Tighter laws or border conflicts may result in congestion and higher demurrage fees, which will increase the cost of freight.

The research of Whitten et al.(2022) showed clear implications for business management. While political and diplomatic relations are largely outside the direct control of private companies, firms must be prepared for the volatility that geopolitical shifts can introduce. Since political relations can have both direct and indirect effects on manufacturers and trading enterprises, business leaders need to be proactive. This involves strategically positioning their companies to seize emerging opportunities while mitigating risks associated with political instability. Importers should incorporate flexibility into their supply chains and logistics operations, while exporters must carefully align supply and demand and develop contingency plans to adapt their marketing strategies. Changes in international trade can also reshape global supply chains, impacting logistics and shipping companies, which traditionally focus on cost, delivery time, and reliability. These firms need to account for political dynamics that might influence the structure of global shipping networks.

3B. CONFLICTS AND WARS

The freight market is affected by war risk due to its ability to cause disruptions and raise costs. The increased geopolitical risk in one area can cause vessels to change their route and take alternative, longer routes. For example, the tension in the Red Sea and the Suez Canal has altered the shipping route for a lot of vessels, forcing them to go around Africa (via Cape of Good Hope). This situation does not only increase transit time but operating cost as well. The Suez Canal, Panama Canal and Bab-el-Mandeb Strait are some of the most important chokepoints and any threat to their security has a global impact. Since vessels take longer routes, the transit time increases, congestion is caused in the ports because more stops at ports are required, the operating expenses are higher and the freight rates increase as well.

On February 2022, the war between Russia and Ukraine severely hindered international shipping and it was anticipated that the continuous disruption of the supply chain, port congestion, and crew issues brought on by the Covid-19 outbreak would worsen. The maritime industry has been impacted by the deaths and injuries in the Black Sea, the interruption of trade between Russia and the Ukraine, and the growing expense of sanctions. The consequences on crew, the cost and shortage of bunker fuel, and the increasing threat posed by cyber risk made day-to-day operations in the industry particularly difficult. The crisis in Ukraine, according to a warning from the International Monetary Fund (IMF), is expected to drive up shipping costs, which are

currently high, and maybe keep them that way for a longer period, leading to inflation. The cost of shipping a container on international transoceanic trade routes grew seven times in the eighteen months following March 2020, and the cost of carrying bulk products increased much more.

The conflict, coupled with a Russian naval blockade, led to the closure of key Ukrainian ports, most notably Odessa. This disruption is significant given that over 70% of Ukraine's exports, including 99% of its grain exports, rely on maritime transport (Georgiou, 2023). As a result, numerous vessels were left stranded in ports or at anchor, with numerous amount of Russian and Ukrainian seafarers facing uncertainty, unable to disembark or return to their home countries. Simultaneously, Russian vessels were barred from entering ports in the United Kingdom and the European Union, with some ships being seized for alleged violations of sanctions. Moreover, Russia's access to critical maritime services has been severely restricted. Many ports have ceased offering bunkering services to Russian-owned or Russian-flagged ships, while major industry players such as engine manufacturers, maintenance providers, classification societies, and insurers have refused to collaborate with Russian vessels (Saul, 2022). These restrictions further isolate the Russian fleet from essential international maritime operations.

For shipping companies and insurers, particularly in the US and EU, sanctions against Russia pose substantial compliance challenges. Western companies halting business with Russia have further complicated legal frameworks, especially concerning contracts and insurance. The prolonged conflict is expected to have wider economic and political consequences. As of now, it has already altered the global trade in key commodities like oil. Increased restrictions on Russian oil exports may drive up the cost and scarcity of bunker fuel, prompting shipowners to explore alternative fuel options. The war has exacerbated existing supply and demand issues within the shipping industry, leading to port congestion, rising freight costs, and longer transit times. According to Clarksons, the effects of the conflict are likely to result in additional inefficiencies throughout the global maritime transportation system. Port congestion, especially for container and vehicle carriers, is nearing historically high levels. The conflict also introduces legal complexities for hull and cargo policies, though marine insurance losses linked to the Ukraine war remain relatively low. Under the conditions

of war and sanctions, some claims are likely to be denied. As pinpointed in the research of Georgiou (2023), in conflict zones like the Black Sea and the Sea of Azov, insurers anticipating a surge in claims under war policies, particularly for vessels damaged or lost due to sea mines, rocket strikes, and bombings. Additionally, insurers may face claims under marine war policies for ships and cargo stranded by the Russian blockade of Ukrainian ports and coastal areas. However, the potential for non-war claims, such as hull and cargo damage, is less clear, as standard marine insurance policies often exclude war-related damages. Most prudent shipowners are expected to purchase additional war insurance to cover such risks, although this coverage typically lasts only seven days and incurs extra costs. Moreover, insurers cannot cover claims subject to sanctions. The Joint War Committee, representing underwriters from both Lloyd's and the International Underwriting Association (IUA), plays a key role in addressing the interests of those involved in marine hull war business in the London market.

Wars and conflicts significantly impact shipping by driving up insurance rates for vessels operating in affected areas. The presence of geopolitical risks leads to higher premiums for hull and cargo insurance, with ships in conflict zones often facing war risk surcharges, which raises overall shipping costs (Rydenfelt, 2013). War risk premiums reflect the elevated threat to vessels, driving up overall transport costs and discouraging shipping in these regions. As a result, prolonged conflicts can force companies to explore alternative routes or modes of transport, such as air freight, which offers greater security despite higher costs. Additionally, fluctuating oil prices during conflicts further influence freight rates, adding to the cost and unpredictability of shipping operations. This combination of higher costs, insurance risks, and potential route changes highlights the complex impact of geopolitical conflicts on international shipping.

Rožić et al. (2022) conducted a survey regarding the fluctuation of containership rates because Russia invaded Ukraine. Using data from scientific articles, surveys from the IMO, the European Union, and the United Nations, along with a stoical analysis of the BDI index, he came to the conclusion that rises in freight costs in the maritime container sector will also have a significant detrimental effect on supply chains. An increase in freight rates in this market will affect the costs of production and the prices of the items that depend on the services offered by this company. Due to global freight rises, the

Russian-Ukrainian War had a detrimental effect on the dry bulk freight sector. (Ahmed Ismail Ahmed Hafez & Zaid Shaker Abuhamour, 2024)

The Joint Committee on International Trade Development declared in June 2022 that the war in Ukraine had increased transportation prices worldwide and stifled trade. There is analytical evidence provided by Zhao et al. (2023), that indicates the cost of spot charter rates could rise dramatically in the event of a geopolitical risk shock. The trade and volume of shipping in the north range ports (Le Havre, Zeebrugge, Antwerp, Rotterdam, Bremen and Hamburg, etc.) have been significantly impacted by the sanctions imposed on Russia by the European Union and its member states. The volume of shipping indicates that many nations that had previously been closely developing with the US and the EU are now searching for partnerships in rapidly developing nations like China and India due to the growing supply dilemma. With global markets becoming more and more saturated, China could take advantage of the opportunity to switch trade partners in order to pursue more trade prospects with more favorable trade policies and an easier-to-navigate environment.

The conflict in Ukraine has significantly disrupted trade and logistics within Ukraine and across the Black Sea region. In the report of UNCTAD (2022) it is stated that this disruption has prompted an urgent need to identify alternative trade routes for Ukrainian exports, placing considerable pressure on both land-based and maritime transportation infrastructure and services. For Ukraine's trading partners, the war has necessitated sourcing commodities from more distant regions, which has led to a surge in global shipping demand and an increase in transportation costs worldwide. This shift has particularly impacted the market for grains, a critical sector due to the major role played by both the Russian Federation and Ukraine in global agricultural markets. Although grain and shipping costs have been rising since 2020, the war in Ukraine has further accelerated this upward trend. A temporary dip in shipping costs prior to the conflict was quickly reversed. In the months from February to May 2022, the transportation costs for dry bulk goods, such as grains, rose by almost 60%. This dramatic rise in both grain prices and freight rates has results in a global increase of approximately 4% in consumer food prices, with nearly half of this surge attributed to higher shipping expenses.

3C. PIRACY AND MARINE SECURITY

In some areas, geopolitical instability frequently results in an upsurge in piracy and terrorist activity. Global maritime trade is seriously threatened by piracy in the shipping and freight sectors, especially in areas like the Gulf of Aden, West Africa, and Southeast Asia. These attacks include ransom demands for crew members, cargo theft, and hijacking of ships. Piracy disrupts supply chains, increases shipping costs, and impacts global commerce. Despite international efforts to combat piracy, it remains a persistent challenge due to complex geopolitical and economic factors. In order to ensure the safety of the crew and the ship enhanced security measures and international cooperation are mandatory. If extra precautions like armed guards or even vessel rerouting are taken, then a raise in operational expenses will appear.

Maritime piracy imposes significant costs on the global maritime sector, estimated between $1 billion and $16 billion annually over the period from 2003 to 2013, according to the International Maritime Bureau (IMB). The economic impact of piracy is felt by exporters, importers, shipowners, carriers, insurance companies, and, ultimately, by consumers. As piracy incidents increase in specific regions, insurance premiums for shipping rise accordingly.

Ships are often forced to alter their routes, such as diverting to the Cape of Good Hope, adding roughly 20 extra days to their journey. This change increases insurance costs by up to $20,000 per trip and elevates charter rates because ships are tied up for longer periods, reducing the available shipping capacity in the market (Emrah , et al., 2019). Inventory costs also rise due to longer transit times. Additionally, when ships are hijacked, owners may pay ransoms ranging from $500,000 to $5.5 million (Hallwood & Miceli, 2015). Consequently, piracy—seen as a source of income for some small groups—incurs substantial costs in international trade.

Emrah et al.(2019) indicates that the correlation between freight rates and piracy incidents is notable. An analysis using bulk carriers as a model shows that positive changes in the Baltic Dry Index (BDI), an indicator of global shipping rates, are associated with an increase in piracy. Specifically, a 100% increase in freight rates leads to approximately a 3% rise in pirate attacks, with changes in freight rates accounting for about 25% of the fluctuations in piracy. This suggests that while freight rates

influence piracy, other factors may play a more significant role due to data limitations or additional unmeasured variables.In contrast, the explanatory power of the tanker ship model is notably weaker. In this model, increases in the Baltic Dirty Tanker Index (BDTI), which measures tanker freight rates, also correlate with a rise in pirate attacks, with a coefficient similar to that in the bulk carrier model (0.029). However, the model explains only about 5% of the variation in pirate activity, further supporting the idea that factors beyond freight rates, such as political stability, security measures, or regional economic conditions, are likely to have a greater influence on piracy trends.

Bensassi et al. (2013) while researching on the price of modern maritime piracy, noticed that the impact of piracy is greater for tankers and ships transporting dirty bulk. So, the frequency of pirate attacks is not only based on the type of goods but also the type of vessel. Moreover, they came to the conclusion that piracy has a substantial effect on the transportation cost between the European Union and the Asian countries. The higher transportation cost is affecting more European countries in comparison to Asian countries. The increased transportation cost through these high-risk areas has led to exploring the option of navigation through the Arctic Ocean. From the end of August until the beginning of October, the path has been free of ice. It has been shown that this route is more cost-effective than the Suez route since it does not require the use of icebreaker ships to accompany commercial vessels.

The International Maritime Bureau Piracy Reporting Centre (IMB PRC) reports that in 2020, 195 piracy and armed robbery incidents were recorded, but this number declined in 2022. The number rose in 2020 as a result of the COVID-19 pandemic, especially in Nigeria and Benin, since the epidemic had detrimental effects on employment, growth rates, international trade, and the world economy.

Ransom payments, piracy insurance premiums, deterrent gear, rerouting ships away from piracy risk zones, naval deployments in piracy hot zones, piracy prosecutions, and organisation resources devoted to combating piracy are among the primary direct costs associated with piracy. The maritime insurance business has increased shipping rates and premiums in response to the growing threat and expense of ransomware, particularly in areas designated as high-risk pirate zones. According to Bowden (2011) there are four primary categories of shipping insurance: cargo, hull, abduction and ransom, and war risk. Avoiding risk zones entirely may be a safer or less expensive

alternative for some vessels, particularly "low and slow" moving ships, which are most vulnerable to piracy attacks. For instance, some ships would choose to take the longer route around the Cape of Good Hope rather than risk passing through the Gulf of Aden and Suez Canal. Before passing through a high-risk area, ship owners may also try to defend their property and crew from pirate attacks by outfitting their vessels with security staff and/or equipment. It is difficult to find reliable statistics on the percentage of ships that buy deterrence gear and what kind of gear they buy.

Maritime piracy has a high cost, especially for traders. In addition to material losses resulting from successful attacks (personal belongings, cargo, ships, ransoms, etc.), unsuccessful attacks may also result in material losses (damage to ships or cargo). Even if they are not facing direct piracy attacks, they are still affected as they pay for insurance premiums, extra security measures for the ship (since vessels need to be enchased), wage bonuses for seafarers that navigate through high-risk areas and cruising speed must be increased to reduce the odds of a piracy attack taking place. All these raise the cost of transportation and the cost of international trade in general. (Robitaille, 2020)

The prevalence of pirate attacks leads to a rise in insurance expenses, which subsequently causes an increase in freight rates. Vessels operating in high-risk regions are compelled to secure additional types of insurance coverage, such as "war risk" or "kidnap and ransom" policies. These specialized insurance policies are essential to mitigate the financial risks associated with piracy, including ransom payments, cargo theft, and damage to ships. As insurance premiums increase to account for these heightened risks, the additional costs are incorporated into freight rates, resulting in higher expenses for shipping companies and, eventually, for consumers.

To minimize the risk of pirate attacks, vessels frequently alter their usual routes, opting for safer but longer journeys. A notable example is the diversion of ships from the piracy-prone Gulf of Aden to the Cape of Good Hope, which significantly extends travel distances by thousands of miles and adds extra days to voyages. This rerouting leads to increased fuel consumption, longer delivery times, and a decrease in available shipping capacity. These factors, combined, drive up operational costs, which are reflected in elevated freight rates.

In general, pirate attacks contribute to increased freight rates by elevating both the operational costs and risks tied to maritime transportation. Shipping companies incorporate these heightened risks into their pricing strategies, resulting in higher freight charges for goods transported through regions vulnerable to piracy. These increased costs have a cascading effect throughout the global supply chain, impacting the prices of goods and affecting the stability of international trade.

3D. GLOBAL SUPPLY CHAIN DISRUPTIONS

Political unrest, sanctions, or military conflicts can lead to possible interruptions in global supply chains and marine commerce routes. These dangers may lead to ship seizure, rerouting, delays, and higher shipping expenses. In chokepoints like the Middle East, it can pose a great threat due to increased transportation costs and major logistical challenges.

To begin with, risks related to politics and economy can cause supply and demand shifts in markets, increases in transportation expenses, and disruptions in the movement of products and services. Rasshyvalova et al.(2024) showed that trade wars, which are sparked by geopolitical conflicts between major economic powers, result in the imposition of tariffs and other trade restrictions from a stance of market protectionism. Consumers will pay more for goods as a result of these policies, which also force businesses to reevaluate their supply chains and search for new suppliers and markets. Multinational corporations are encouraged by geopolitical conflict zones to create more adaptable and sustainable supply chain management methods, particularly by diversifying their suppliers and implementing backup logistics.

Shipping companies are forced to reconsider their supply chain strategies in the face of these interruptions. This entails reconsidering supplier relationships, reevaluating the supply chain's overall design, and taking manufacturing and distribution centre relocation into account. The study conducted by Bukola A. Odulaja et al. (2023) draws attention to the bullwhip effect, which describes how slight shifts in customer demand cause more significant fluctuations in orders made further up the supply chain. To

lessen such disruptions, the report recommends a number of preventive measures, such as purchase limitations and ongoing inventory reviews.

Disruptions in the supply chain have a major effect on goods because they lead to delays, inefficiencies, and higher expenses. Goods reception and transportation by goods carriers are delayed when production, sourcing, or distribution processes are disrupted—for example, by labour strikes, natural disasters, or material shortages. This results in increased operating expenses, overloaded or underutilised transport capacity, and congestion at ports. Thus, some companies might have to modify their routes, raise their rates, or experience service outages, all of which have an impact on the delivery of goods and the effectiveness of the supply chain as a whole. This is possible to lead to freight volatility.

In 2020 during COVID-19 period, a lot of phases in the supply chain unfolded. This phenomenon caused disruptions in the global supply chain. According to Notteboom et al. (2021), the first stage, which began in early 2020, involved a supply shock in China, where lockdown procedures led to significantly lower Chinese production. Between mid-January and early March 2020, the lockdown limited the industrial base and impacted the majority of the workforce. Due to a spike in demand and the reallocation of inventories, many industries experienced shortages at the same time. From the standpoint of the supply chain, COVID-19 is developing in a number of successive stages. A demand shock with backpropagation along supply chains constituted the second phase, which started in mid-March 2020. Due to decreased consumer and industrial confidence as well as a decrease in retail activity, the various lockdown measures that were put in place around the world caused a reduction in worldwide demand. In this period the demand for containerships was really low at first, but then it increased as the demand for supplies was getting higher.

Furthermore, ports may close temporarily or permanently in politically unstable locations, resulting in damage to infrastructure and delays in the loading and unloading of cargo. This might lead to longer transit times, increased operational costs, and increased congestion at other ports. Funding from investors may be difficult to come by for projects in areas that are prone to political unrest or war, which could leave them with insufficient capacity and infrastructure.

A notable example of overcoming geopolitical risks in supply chains occurred in January 2024, when container freight rates surged due to US and UK airstrikes in Yemen. These strikes targeted Iran-backed Houthi forces responsible for attacks on shipping in the Red Sea. Consequently, most container ships were forced to avoid the Suez Canal, a critical trade route handling 12% of global trade. Ships were rerouted around the Cape of Good Hope, increasing transit times and operational costs significantly. The Shanghai Container Freight Index, which tracks container shipping rates from Chinese ports, rose by 114% since mid-December 2023. Additionally, tariffs on routes to Europe and the US West Coast escalated sharply (Rasshyvalova, 2024).

This disruption caused widespread logistical challenges, with shipping companies facing elevated costs and delays. The alternative route added approximately 10 days and $1 million in fuel expenses for each voyage between Asia and Europe. Major importers such as Tesla, Volvo, and Ikea experienced product shortages and delays. The overall decrease in available shipping capacity on key routes led to increased transportation tariffs and surcharges, which are expected to raise the prices of many goods globally. In response, various companies have effectively navigated these geopolitical risks by adopting adaptive strategies. Some businesses diversified their production bases to mitigate the effects of tariffs and trade barriers, while others leveraged advanced analytics to forecast and manage the impacts of political instability in supplier countries. These approaches illustrate how companies can proactively address challenges posed by geopolitical disruptions in global supply chains (Meehan, 2024).

Geopolitical events are likely to influence the adoption of more stringent safety and environmental laws. International agreements, such as the sulphur cap imposed by the International Maritime Organisation (IMO), are subject to geopolitical disputes and hence affect the operational costs of the maritime industry.

4. CONTAINER TRADE CHARACTERISTICS

The container trade industry is responsible for the effective transportation of commodities all over the world through standardized shipping containers. Intermodal transportation, which enables smooth transfers between trucks, trains, and ships, is ideal for it. This business uses economies of scale to save costs and link supply chains globally thanks to its large container ships and global hubs. Advancements in technology, such as automated ports and smart containers, have further optimized operations. However, market volatility, environmental concerns and regulations have a great impact on the container trade. Nevertheless, the container trade remains crucial in shaping modern trade and logistics.

According to a report from Lotus containers (2024), the evolution of container trading has significantly streamlined international shipping by leveraging technology, making it easier for traders to transport goods securely across borders. Shipping container companies now collaborate with container depots worldwide, allowing them to lease or sell containers in regions where they do not have direct operations. This networked approach enables traders to access containers globally, facilitating the leasing or purchase of containers from virtually any location. Container trading offers traders the flexibility to lease, buy, or sell used containers when they are no longer needed. This adaptability helps traders avoid long-term storage concerns, allowing them to easily manage their container assets based on current business needs. Also, the variety of container types and sizes available allows traders to scale their operations efficiently.

Apart from that, many shipping companies provide a buyback option, allowing traders to sell containers back to the company once they are no longer useful. This arrangement ensures that traders receive a fair value for used containers, making it a financially appealing option for managing container assets. The container industry plays a crucial role in facilitating international trade, driving global economic growth. Containerisation enhances the efficiency of trade operations, contributing to the profitability and productivity of the shipping sector.

In the container trade industry, economies of scale reduce shipping costs per unit by enabling large vessels to transport vast quantities of goods efficiently across global routes. Due to the lower unit costs, break-even load factors for larger vessels typically fall below. As vessel size increases, it is generally assumed that transport service unit costs will fall. An additional implication is that, if freight rates remain constant, profits per unit of transportation service rise as vessel size increases (Seok-Min, 1998).

The industry is subject to significant fluctuations in freight rates, which are influenced by factors like global economic conditions, fuel prices, and supply-demand imbalances. Also, the new regulations imposed by the International Maritime Organisation aiming to reduce and generally the movement towards sustainability in the industry, lead the container trade to alterations.

4A. FREIGHT RATE DETERMINANTS FOR CONTAINERS

Compared to other types of trades, container trade uses the seaborne trade volume and transport distance as demand indicators more frequently. This is perhaps due to the fact that the liner industry handles too many different kinds of cargo to utilise a commodity price indication. Since shippers in the container sector are the ones receiving the transport services—as opposed to charterers who may handle the cargo transport independently in the dry bulk and tanker sectors—factors indicating service efficiency are frequently taken into account when analyzing freight rates in the container sector. Examples include service frequency, connectivity (measured by the number of services) or connectivity index, and port conditions, such as port infrastructure and port utilization. Trade imbalance is one more unique factor that affects container freight rates, according to Liu (2024). This is reasonable because the expense to the liners of repositioning empty containers due to trade imbalances can be substantial. Higher trade deficits are associated with lower export container freight rates for a nation, according to UNCTAD. In addition, market competition has been included particularly for the container industry, given the industry's history of recurrent mergers and acquisitions, the creation and dissolution of shipping alliances, and rising levels of market concentration. The number of carriers and the market concentration index are two

measures of market competition in the container shipping sector that have been found to have a significant negative impact on container freight rates.

Freight rates in the container trade are influenced by a complex interplay of factors that shape supply and demand dynamics (Leopoldo & Manzanero, 2009). Key determinants include fuel prices, vessel capacity, and global trade volumes, all of which can fluctuate due to economic cycles and geopolitical events. Port congestion, shipping routes, and container imbalances between import and export regions also play significant roles. Additionally, external factors such as regulatory changes and environmental policies impact shipping costs. Together, these variables create a constantly shifting landscape for freight rate determination in the container trade industry (Lindy Wan Yew Heng , 2008).

One of the most important operating expenses is bunkering. The cost of bunker fuel can vary significantly even with slight variations in price or consumption. Therefore, limiting the amount of bunker fuel used and choosing the right bunkering ports are crucial for lowering the cost of bunker fuel. In the research of Wang et al.(2019) the primary source of freight revenue is container transportation revenue. Determining the best shipment plan will impact the freight revenue because freight prices vary between ports and for different kinds of merchandise. Determining the loading method becomes more challenging during peak seasons (like Christmas and Chinese New Year), when there is typically a high demand for freight transportation.

Hydrocarbon fuels are used extensively by tankers, bulk carriers, and containerships, which are key modes of transportation. The paper published by Ahn et al. (2019) shows that twenty-four percent of global shipping emissions are attributed to containerships that consume a significant percentage of hydrocarbon fuel. Global warming and climate change have prompted the implementation of eco-friendly shipping laws. IMO adopts EEDI (energy efficiency design index) and ECAs (emission control area), which reduce emissions of CO2, SOX, and NOX. For example, at the 72nd meeting of the MEPC (EC 2018), "the draft of the Initial IMO Strategy on Reduction of GHG Emissions from Ships" was adopted as Resolution MEPC., the first step in the GHG reduction roadmap. At that meeting, the EEDI was reemphasized as a mandatory requirement for newly built ships. So in order to adjust to these new regulations shipping companies should invest in new vessels with different types of mechanisms and different fuels. This

process needs a specific amount of time to be completed, one to three years depending on the demand. Meanwhile, shipping companies will either pay “fines” for exceeding GHG emissions or they will need to reroute their vessels. In both options, the operational expenses will increase and this cost will be added to the freight amount.

4B. GEOPOLITICAL RISKS IMPACT ON CONTAINERS

After the start of the latest Israel-Hamas war in October 2023, Yemen’s Houthi rebels began attacking vessels in the Red Sea. In response, shipping companies have altered their routes to avoid the Suez Canal and the Red Sea. Detouring around the Cape of Good Hope has extended voyages by approximately 3,500 nautical miles and increased shipping times by at least 12 days (Baraniuk, 2024). Trade flows between Europe and Asia, which ship primarily through the Suez Canal, have been particularly affected.

In the analysis of Dunn and Leibovici (2024), the global ramifications of recent disruptions in shipping for international trade and shipping costs are explored. To assess the impact on global trade, data from IMF PortWatch are utilized, which tracks trade volumes across major global ports. To differentiate between local and global impacts of the Red Sea disruptions, the 1,378 ports included in the data were divided into two categories. The first group, referred to as "Eurasian ports," includes ports that depend on trade passing through the Suez Canal to reach key destinations such as East Asia, Europe, the Middle East, and South Asia. The second group consists of ports that are less reliant on the Suez Canal for accessing major markets, such as those in Latin America, North America, and sub-Saharan Africa.

Moreover, in the same research of Dunn and Leibovici (2024) a comparison of trade volumes between these groups shows that Eurasian ports experienced a noticeable decline in trade between October 20, 2023, and January 28, 2024, compared to the previous year, with the trade gap growing following the onset of the Red Sea disruptions. Conversely, ports outside this region initially maintained stable trade levels relative to the previous year, but a significant decline of roughly 20% emerged in recent weeks. While the full causes behind this shift are still being explored, preliminary findings suggest that local disruptions are beginning to affect global trade flows.

In order to pinpoint the differences between the years, a comparison between the Cape of Good Hope, Suez Canal, and Panama Canal, from October 2023 to February 2024 is going to be helpful. In their research they compared the 2023-24 data with the previous year (2022-23), showing trade volumes in millions of metric tons based on a 7-day moving average. More specifically, there was a dramatic increase in trade volumes in late December 2023, peaking around January 2024 and remaining elevated compared to the previous year for the Cape of Good Hope. This suggests a shift in shipping traffic to the Cape of Good Hope, likely due to disruptions in the Suez Canal. Also, a significant decline in trade volumes appears to start in mid-December 2023, with a sharp drop by January 2024, for the Suez Canal. This is much lower than the previous year's levels, suggesting that the Suez Canal's capacity was heavily affected during this period. This decline reflects the rerouting of ships via Cape instead of the Suez canal, due to security concerns. In both cases while viewing Panamas' canal data, the 2023-24 and 2022-23 were relatively stable trade volumes with only slight fluctuation. This indicates that the Panama Canal was less affected by the global trade disruptions in the other regions during this period.

Sedat Bastuget et al (2023), conducted research on the risk mitigation in the container ship market during corona virus. Through interviews with professionals from big shipping container lines, they found out that transportation delays and the associated instability of schedules were not their biggest concern since their shippers would show understanding. Rather, shippers worldwide have voiced their displeasure with carriers' collective business methods, exorbitant freight charges, and blank sailings. Although the corona virus pandemic may have momentarily lowered fuel prices and shipping demand. In order to reduce the risks connected with fluctuating fuel prices, shipping lines would still need to control their fuel expenses and take into account tactics like fuel hedging. Furthermore, shipping lines may encounter additional difficulties and hazards associated with fuel prices and availability as the world continues its shift to a low-carbon economy. For this reason, it is even more crucial that they manage these risks by putting mitigation strategies like slow steaming into practice.

Globally, there has been an increase in delayed shipments as a result of the pandemic, wars, and conflicts. This occurs when ships are either stranded at ports with no one to help load and unload them or are having trouble at sea because of bad weather.

According to DNV GL's Maritime Forecast to 2050 (2021), the COVID-19 pandemic has caused significant supply chain disruptions, such as port closures, staff reductions, and delays. Container backlogs brought on by these delays lead to port congestion, an increase in cargo theft, and other security-related issues. According to Muhammad (2023), about 60% of ships sailing from Europe to Asia experienced delays in the second quarter of 2022 alone. The economy has been severely impacted by the pandemic, which has raised competition and reduced demand. These economic factors may affect the security of the container supply chain by increasing the likelihood of cargo theft and piracy. A UNCTAD assessment highlights the increased danger of piracy as a result of ships' increased vulnerability and less patrols during the pandemic.

Geopolitical risks significantly impact the container ship market by disrupting supply chains, influencing shipping costs, and altering trade routes. Political tensions add to transit times and fuel costs. Additionally, conflicts like the Russia-Ukraine war impact key maritime routes and ports, reducing capacity and raising insurance premiums due to increased risks in conflict zones. Sanctions imposed on countries or shipping lines linked to political turmoil can also restrict the availability of container vessels and lead to costly detours. Furthermore, regulatory responses to these tensions, including environmental standards and security protocols, can increase operational costs, which are often passed on to consumers. All the above lead to delays and longer transit time for shipments. Altogether, geopolitical uncertainties inject volatility into the market, challenging shipping companies to adapt to dynamic trade flows and escalating costs.

5. IMPACTS OF INCREASED GEOPOLITICAL RISK IN THE RED SEA

Geopolitical risk refers to the potential for international political events to disrupt global markets, trade routes, and economic stability. One of the main examples of such a risk is the Suez Canal, a vital maritime chokepoint that links the Red Sea with the Mediterranean Sea. Any instability in the area, whether it be armed warfare or political upheaval, has the potential to seriously disrupt international trade by jeopardizing the safety and smooth functioning of this crucial route. Because of this, the Suez Canal becomes a key topic when talking about geopolitical risk and the resiliency of the global

In the past few years the trade lines and the routes of the vessels have changed owing to weather-related events such as the drought that has reduced the Panama Canal's

capacity by 36% (Associated Press, 2024), military conflicts (e.g. the Russia-Ukraine war) and marine accidents and vessel groundings, such as the "Ever Given" incident that occurred in March 2021 and caused the Suez Canal to be blocked for six days. The crisis in the Red Sea is another example of an occurrence that significantly alters the dynamics in shipping and logistics.

Over the past year, the situation in the Red Sea region has escalated, as Houthi militants have stepped up their attacks on vessels, showing their mutual support to Palestinian fighters in Gaza. They are targeting vessels that pass through this area. These attacks have resulted in interruptions in shipping worldwide, pushing numerous companies to reroute their vessels via Cape of Good Hope. In addition, the raise in war insurance premiums was also another fact that influenced and shaped the shipping industry. (Ahmad & Talmiz, 2024)

The Suez Canal, which unites Europe, Africa, and Asia and connects the Red Sea to the Mediterranean Sea, handled between 12% and 15% of the world's marine traffic during 2023. In the research conducted by Schwarzenbeg and Adres (2024), it was highlighted that pivotal route holds great importance for commerce in certain goods; based on estimations, it has managed 25% to 30% of all cargo containers, 12% of oil carried by sea, and 8% of the grain trade in, and seaborne liquefied natural gas lately.

The world's largest shipping companies have temporarily changed the Suez Canal route with a more extensive one that requires navigation via the Cape of Good Hope due to safety concerns. According to statistics gathered by Haralambides et al.(2024), container ship throughput in the Suez Canal dropped to roughly 33% in 2024, while merchant ship throughput decreased to less than 60% of its peak era. The rerouting of merchant vessels has had a substantial impact on international logistics, as the Suez route contributes 30% of the global yearly volume of container shipping. Apart from the nearly doubled operating expenses, logistic costs and delivery delays, this rerouting also raises some environmental concerns. The UNCTAD estimates that the alternate routing for maritime routes from Southeast Asia to Northern Europe might result in an extra 70% of greenhouse gas (GHG) emissions. With tensions rising, the maritime sector is predicting that this state of affairs would last until at least the end of 2024. The

environmental impact of container logistics can be detected easier than the intricate elements driving up freight charges; longer sailing times and more frequent temporary stops result in higher fuel consumption and higher greenhouse gas emissions.

The discrepancy between travelling via the Red Sea, Suez Canal, and Mediterranean Sea and bypassing the Cape of Good Hope was used to compute the difference in route lengths before and after rerouting. The researchers Peng, Wang and An (2024) found out that the number of voyages originating and arriving in Singapore was increased from 23% to 42%, perhaps as a result of the dilution effect of large distances. Assuming that the speed of the vessel throughout the voyage is steady the fuel consumption and greenhouse emissions increase accordingly with the length of the voyage. However, since the vessel route is longer and the stops in ports are more, GHG emissions are likely to increase further due to delays.

These security crises have far-reaching economic implications. According to the study conducted by E. Rodriguez-Diaz et al.(2024), the operational costs of impacted vessels might rise by an average of 18% with each Houthi strike episode. This covers the price of gasoline used on longer journeys, the cost of delays, and the expense of extra security measures required because of the greater threat level. When these disruptions compound, not only can shipping corporations suffer significant financial losses, but economies that depend on timely maritime commerce may also suffer significant costs. This subtle disturbance highlights the complex and regional impact of geopolitical conflicts on maritime logistics, offering a singular instance of supply chain disruption that differs greatly from the widespread disruptions brought about by larger-scale events. By means of a comparative analysis, the unique consequences of the Houthi conflict expose how focused geopolitical tensions can result in substantial traffic rerouting and intensify security concerns, underscoring the vital necessity of flexible and robust shipping practices in the face of regional instability. The tension complicates navigation through the Red Sea and essentially turns the Mediterranean Sea into a dead end, severely restricting alternative shipping routes and forcing a reevaluation of global shipping paths (Baker, 2024). This disruption highlights the specific, localized effects of geopolitical conflicts on maritime logistics, offering a perspective on supply chain disruptions that differs from those caused by global events. By comparing cases E. Rodriguez-Diaz et al.(2024), the unique impacts of the Houthi conflict are revealed, showing how localized geopolitical tensions can necessitate major detours and heighten

security risks, emphasizing the need for adaptable and resilient shipping operations in response to regional instability.

Increased geopolitical risk in the Red Sea can disrupt global supply chains by delaying shipments and forcing longer routes. Freight costs rise due to higher insurance premiums, fuel expenses, and port congestion. Environmental risks include oil spills and damage to marine habitats from conflicts, leading to long-term degradation of ecosystems. This instability impacts global trade, logistics and the environment.

5A. SUPPLY CHAIN DISRUPTIONS

Suez Canal in the north and Bab al-Mandab Strait in the south serve as the two entrances to the Red Sea, one of the main transoceanic trade routes in the world. An average of 8.8 million barrels of oil are shipped annually through the Bab al-Mandab Strait, according to the US Energy Information Administration (2023). This amounts to 8.7% of the 101.7 million barrels per day that the International Energy Agency (2023) estimates as the world's daily need for oil. Approximately 30% of the world's container traffic and 12–15% of the world's goods commerce typically travel via the Suez Canal (UNCTAD, 2022). According to information from Lloyd's Intelligence, prior to the onset of the Red Sea crisis in mid-November, over 1500 commerce boats would typically pass through the Suez Canal each month. Even though there is not a complete picture regarding the total impact on supply chain, companies and shipping lines are trying to lessen the crisis's prospective effects on logistics.

By mid-December 2023, security risks grew to the point where Maersk, MSC, BP, and other maritime corporations ceased canal passes or started to divert freight via the Cape of Good Hope. The research of Haralambides and Cullinane (2024) provides information regarding the number of transit through Suez Canal over the years by vessel type. It states that from the second half of 2023 the number of vessel transiting the Suez Canal is significantly lower for every type of vessel.

An established but costly alternative to the Suez Canal is the Cape Route, which involves sailing around the Cape of Good Hope. This detour adds approximately 3,500 nautical miles to the voyage, translating to roughly 12 additional sailing days (Baraniuk,

2024). According to the article published by UNCTAD (2024) this alternative route increases transit time by 30%. Longer transit times and travel lengths reduce the effective worldwide capacity for container transportation by about 9%. For instance, it takes 56 days and eight ships to travel round-trip from India to Europe. An additional ship will be required if the trip takes sixty-three days. Vessel transits across the Suez Canal have drastically decreased, falling 42% from their 2023 peak. The tonnage of ships entering the Gulf of Aden decreased by over 70% between the first half of December 2023 and the first half of February 2024, indicating a dramatic shift from the Gulf of Aden to the Cape of Good Hope. In contrast, the gross tonnage of ships arriving at the Cape of Good Hope climbed by 85% (7-day moving average) by the first week of March 2024 as compared to the first half of December 2023. Despite the increased costs and extended transit times, most container carriers have suspended their Red Sea operations. CMA CGM was initially the only major carrier transiting the Red Sea, escorted by the French navy, but it also shifted to the Cape Route by early February 2024 (Haralambides, H. & Cullinane, 2024) .

According to Linerlytica data presented in the research of Haralambides and Cullinane, between December 15, 2023, and January 7, 2024, a total of 354 container ships were diverted to the Cape Route, representing a capacity of 4.65 million TEU, or 16.4% of the global container fleet. Clarksons research provided similar statistics, with 364 container ships and a capacity of 4.2 million TEU by January 9, 2024. This suggests that around 80% of the container ships that would typically use the Suez Canal were rerouted. Goldman Sachs reported in late December 2023 that approximately 30% of global container trade was affected, with 70–80% of vessels rerouted, while UNCTAD estimated that trade volume through the Suez Canal declined by 42% over two months. Based on service announcements from carriers, it is expected that rerouting via the Cape will continue until security conditions in the Red Sea and surrounding areas improve.

The widespread adoption of the Cape Route has had a significant impact on Mediterranean hubs such as Piraeus, Genoa, Malta, and Valencia. The Mediterranean, often regarded as a crucial global maritime hub, connecting Europe, Africa, Asia, and North America, is now facing severe disruptions due to the trade crisis caused by the security threats in the Red Sea and the associated rerouting strategies. Moreover, according to the International Forwarding Associations (2024), the crisis has also

caused significant congestion at ports in Barcelona, Shanghai, Malaysia, and Singapore. This congestion arises from an increased number of vessels arriving outside of their regular operational windows due to rerouting and detours. As a result, delays at these ports have led to the cancellation and postponement of sailings, with many ships unable to depart as originally scheduled.

Haralambides and Cullinane (2024) have highlighted the fact that rerouting has also led to a significant rise in ship emissions. Longer voyages increase total fuel consumption and, consequently, emissions. For a typical Asia–North Europe liner service, the rerouting results in a 42% increase in emissions per vessel and a 67% rise in total emissions for the fleet needed to sustain weekly service. This escalation in emissions presents a challenge for the shipping industry, which is required to meet the International Maritime Organization's (IMO) emission reduction targets: at least 20% by 2030, and 70% by 2040, compared to 2008 levels. Furthermore, the shift away from the Suez Canal has led to a considerable loss in toll revenues for the Suez Canal Authority (SCA). In the fiscal year 2022-2023, the canal generated a record $9.4 billion in toll revenues, representing 2% of Egypt's GDP. However, SCA reported a 40% reduction in toll revenues during the first two weeks of 2024 compared to the same period in 2023, amounting to an estimated loss of $175 to $350 million in transit fees for container vessels between December 2023 and January 2024.

In the report of BIMCO (2024), the supply of ships is projected to increase by an average of 10.3% in 2024 and 6.3% in 2025. Following an anticipated rise in shipping activity in 2024, vessel speeds are expected to decrease in 2025. It is also expected that rerouting through the Cape of Good Hope will continue to influence shipping throughout 2024. Forecasts indicate that ship demand will rise by 15.5% in 2024, with a potential decline of 5.5% in 2025 if vessels return to the Suez Canal route. Additionally, ship deliveries are anticipated to reach a record high in 2024, surpassing the previous peak set in 2023. Overall, the fleet is expected to expand by 14.5% between the end of 2023 and the end of 2025. Moreover, Spot freight rates from Shanghai (as tracked by the Shanghai Containerized Freight Index, SCFI) reached their peak in early July, but have since decreased by more than 30% due to a combination of lower cargo volumes and an increase in available capacity in certain trade routes. As the market transitions into the fourth quarter of 2024 and into 2025, further reductions in freight

rates are expected, along with a weakening of time charter rates, particularly if vessels are able to resume their regular routes. Driven by a renewed interest in long-term container contracts, the global order book for new ships has grown by an additional 5% over the past three months, leading to higher prices for new vessel construction. If normal shipping routes are restored, it is anticipated that ship demand will decrease by 5-6% in 2025. Conversely, if the rerouting through the Cape of Good Hope continues, ship demand is expected to increase by 3.5-4.5% during that year.

5B. FREIGHT RATES AND SURCHARGES

The Red Sea crisis, driven by escalating geopolitical tensions and maritime security risks, has significantly impacted global freight rates. This vital maritime route, which connects Europe, Asia, and Africa via the Suez Canal, plays a critical role in global trade, with a substantial portion of the world's goods passing through it. Any disruption in the Red Sea region, whether due to military conflicts, piracy, or blockades, directly affects shipping operations. The result is increased freight rates as insurance premiums rise, shipping routes are lengthened, and supply chains are strained. These challenges reverberate across industries, from energy and consumer goods to technology, reshaping global logistics strategies and trade dynamics.

The crisis in the Red Sea has significantly influenced spot freight rates, as anticipated. According to the research of Haralambides et al. (2024), the data from the Shanghai Containerized Freight Index (SCFI), showed that shipping costs for containers to Northern Europe saw a sharp rise from 707 USD per TEU in mid-November 2023 to 3,103 USD per TEU by the third week of January 2024—a 339% increase. This surge was followed by a slight decrease, bringing the rate to 2,723 USD per TEU by the sixth week of 2024. Despite this steep rise, the freight rates remain below the unprecedented levels experienced during the peak of the COVID-19 pandemic in 2021 and early 2022. The crisis intensified around mid-December 2023, contributing to the increase in rates. Additionally, the elevated freight costs are partially attributed to concerns over limited shipping capacity and the availability of containers, particularly in the lead-up to the Chinese New Year Spring Festival (Warden, 2024).

Haralambides et al (2024), also observed that the rise in freight rates was not limited to routes to Northern Europe; similar trends are seen in other trade lanes. For example, by mid-January 2024, the SCFI for the Trans-Pacific route hit 3,974 USD per TEU, while the China–East Coast North America (ECNA) route saw rates reach 5,813 USD per TEU. The latter route has been particularly affected by a combination of the Red Sea crisis and low water levels in the Panama Canal, which have constrained vessel passage since early 2023. This situation has led to changes in shipping patterns, with some Asia-to-ECNA services rerouting from the Panama Canal to the Suez Canal. However, with disruptions now also affecting the Suez Canal, many carriers are favoring Trans-Pacific routes to U.S. West Coast ports, where cargo can then be transported inland via rail. This shift has resulted in increased throughput at West Coast North America (WCNA) ports, which had been losing market share to ECNA ports in recent years.

The long-term container shipping market may also feel the effects of the Red Sea crisis if conditions persist. Future contracts could be negotiated at significantly higher rates, and some container carriers might opt not to honor existing long-term agreements, preferring instead to engage in the spot market (Levine, 2024). Shippers may experience operational consequences as a result, such as a higher chance of container rollings.

The longer Cape route absorbs capacity, resulting in fewer available slots per unit of time; this route also incurs additional fuel costs due to its longer distance; and shippers' negative expectations regarding the (un)availability of capacity in the future all contribute to the higher freight rates.

The elevated freight rates are driven by multiple factors. One major cause is the diversion to the longer Cape of Good Hope route, which reduces available shipping capacity by prolonging transit times and increases fuel consumption due to the greater distance. Additionally, market expectations about potential future capacity shortages are contributing to the upward pressure on rates. Ancillary costs, including insurance premiums, have also seen a notable rise. Prior to the onset of the crisis, war risk insurance premiums were approximately 0.05% of the vessel's insured value. However, these premiums have now escalated significantly, ranging between 0.75% and 1% of the insured value of the ship (Mishra, 2024). This percentage is aligned with the founding of Haralambides et al.(2024) according to whom, this is translating to 1.1 to

1.5 million USD for a 20,000+ TEU container ship valued at 150 million USD. Despite increased insurance and fuel costs, the absence of canal fees has narrowed the cost difference between the Suez and Cape routes, discouraging a return to Suez if risks remain elevated.

Shipping lines have responded to these additional costs by introducing a range of surcharges. Since late November 2023, many carriers have implemented 'war risk surcharges' for shipments. In reference to the report from CNBC (2023), Maersk stated that a standard 20-foot container shipped from China to Northern Europe now incurs an additional fee of $700. This surcharge is composed of a $200 Transit Disruption Surcharge (TDS) and a $500 Peak Season Surcharge (PSS). Containers destined for the East Coast of North America will face a $500 surcharge, including the $200 TDS and a $300 PSS. Furthermore, Maersk indicated that the Suez Canal disruption has led to the introduction of emergency contingency surcharges across various routes within its network. Similarly, CMA CGM announced additional charges, with a $325 surcharge per 20-foot container on the North Europe to Asia route, and a $500 surcharge for shipments from Asia to the Mediterranean.

According to Xeneta (2024) , on the trade route from the Far East to the U.S. West Coast, average spot market rates were projected to rise to 5,170 USD per FEU by June 1, surpassing the peak rates observed during the Red Sea crisis, which were 4,820 USD per FEU on February 1. Similarly, for shipments from the Far East to the U.S. East Coast, spot rates were expected to reach 6,250 USD per FEU by June 1, which is just below the peak of 6,260 USD per FEU seen during the Red Sea crisis.

Shipping costs to the Mediterranean have also climbed. In the research of Haralambides (2024), it is established that by the third week of January 2024, a 252% rise to 4,037 USD per TEU was observed, with a slight reduction to 3,753 USD per TEU in the sixth week of 2024 (in accordance with SCFI data). Other shipping indices report similar increases; the Drewry World Container Index for a forty-foot equivalent unit (FEU) from China to Northern Europe jumped to 4,406 USD in mid-January 2024, a 282% increase since mid-November 2023. Additionally, data from Xeneta indicate that ocean freight rates from the Far East to Northern Europe increased by 124% over the same period.

The longer Cape route absorbs capacity, resulting in fewer available slots per unit of time; this route also incurs additional fuel costs due to its longer distance; and shippers' negative expectations regarding the (un)availability of capacity in the future all contribute to the higher freight rates.

A report posted by Inchcape (2023), demonstrated that the Suez Canal Authority (SCA) intended to implement an increase in transit fees for vessels passing through the canal, ranging from 5% to 15%, depending on the ship type. For container ships, the transit costs would specifically rise by 15%. However, this fee increase will not apply to container vessels traveling directly from Northwest European ports to destinations in the Far East, which the SCA has exempted from the adjustment.

The demand and supply imbalance in the container market is not projected to structurally improve despite the higher freight rates, owing to the Red Sea issue and diversions around the Cape. As previously indicated, beyond demand projections, a significant amount of new vessel capacity is expected in 2024 and 2025. The Red Sea crisis is most likely just going to be another reason contributing to liner shipping's increasing overcapacity. That is to say, there is enough space to accommodate the current level of interruptions in the Red Sea because the world's container market is becoming so severely oversupplied with new ships.

Haralambides and Cullinane (2024) pinpointed that rerouting via Cape of Good Hope could have significant effects on the Mediterranean Sea, which links the four continents. It also serves as a waterway passage for the vessels entering and exiting the Straits of Gibraltar. In the container shipping market, carriers may be encouraged to divide services on key Asia–Europe routes by increasing the use of transshipment hubs near the Straits of Gibraltar, such as Tanger Med, Algeciras, Sines, and Valencia. These hubs could also serve routes to the U.S. East Coast, along with major northern European ports like Rotterdam, Antwerp-Bruges, and Hamburg. Similarly, West African ports such as Abidjan, Cotonou, Lagos, and Lomé could offer alternatives for splitting services between the U.S. East Coast and Europe. These measures would help ease the strain on large deep-sea vessels and address potential capacity issues caused by rerouting via the Cape.

There has been a temporary shock to the container industry as a result of the Red Sea disturbances. For instance, because of the unpredictability and volatility surrounding the decisions of carriers to cease Red Sea transits or to begin rerouting via the Cape, the Asia-Europe route saw significant disruptions in late December 2023 and early January 2024. While some ship departures were delayed in Asia, others had to make essential course corrections or adjustments to their port call sequences while on their way. In the end, most major container carriers chose to halt operations in the Red Sea, which led to a better understanding of critical logistics factors like anticipated transit durations and vessel capacity. The International Forwarding Association bearing in mind that shipping rates have surged by 270% since the escalation of the wider conflict in the Middle East (rates rose from 1,389.5 USD in October 2023 to 5,182 USD in August 2024); forecasts that further increases are anticipated, as experts predict sustained strong shipping demand until after the Chinese New Year in February 2025.

5C. ENVIRONMENTAL FOOTPRINT

The ongoing crisis in the Red Sea has far-reaching consequences for the environmental footprint of global maritime shipping. Heightened geopolitical tensions in the region have forced vessels to reroute, often requiring longer and less direct paths around conflict zones. This rerouting leads to increased fuel consumption and higher emissions of greenhouse gases, thereby exacerbating the environmental impact of the shipping industry. Additionally, the intensified use of alternative routes may place undue pressure on marine ecosystems, increasing the likelihood of accidental spills or environmental degradation.

Shipping companies are currently redirecting their vessels around the Cape of Good Hope instead of using the Suez Canal. To compensate for the additional distance involved in this detour, they are also increasing cruising speeds (Bimco,2024). Financial Times (2024) report that this shift has the potential to end nearly a decade of "slow steaming," a strategy that shipping lines have used to reduce fuel consumption and minimize CO2 emissions. Slow steaming, which involves sailing at reduced speeds, has been promoted as an effective way to decrease emissions; studies have shown that a 10% reduction in speed can lead to a 27% decrease in a ship's emissions. However, with the significantly longer routes now required, analysts from Sea-Intelligence

forecast an increase in CO2 emissions. They estimated that a modern container ship at 1% speed produces 2.2% rise in fuel consumption, so an increase from 14 to 16 knots will increase the consumption by 31% (Sea Inteligence, 2024). Therefore, GHG emissions for a round trip could increase up to 70%. These findings are totally aligned with findings of Stausboll (2024), who apart from the 30% increase in consumption and GHG emissions, also highlights the fact that the Carbon Emissions Index (CEI) hit 100. It is the second time the 100 point mark has been breached.

According to the research of Peng et al. (2024), the International Maritime Organization (IMO) put a halt to talks on marine carbon pricing in 2013 due to regional disparities, regional trade protection, administrative difficulties, and the problem of carbon leakage. In 2018, carbon pricing, also referred to as market-based measures (MBMs), was included in the International Maritime Organization's (IMO) planned medium-term strategies, with a potential worldwide implementation anticipated by 2030. In the revised 2023 IMO strategy, the deadline for implementing the maritime carbon pricing scheme was moved forward to 2027. This global initiative has prompted consideration of integrating maritime emissions into regional carbon pricing systems. One prominent example is the European Union Emissions Trading System (EUETS), which, after over five years of legislative negotiations, adopted formal regulations in June 2023. Under these rules, 100% of greenhouse gas (GHG) emissions, including CO2, CH4, and N2O, from cargo and passenger ships of 5,000 gross tonnage or more travelling between ports within the European Economic Area (EEA) will be covered by the ETS. Additionally, 50% of GHG emissions from voyages between EEA and non-EEA ports will also be subject to the scheme's compliance requirements. The phased implementation of this policy began in 2024, with emission allowances set to increase incrementally, requiring companies to surrender 40% of their emissions in the first year, 70% in the second, and 100% by the third year. Shipping companies, particularly those responsible for fuel costs and the environmental externalities of their routes—such as global container lines like MSC and Maersk—are held financially accountable for these emissions. This recently adopted carbon pricing plan is under uncertainty due to the recent rerouting to avoid the Red Sea.

The research by He Peng et al. (2024) assesses how recent geopolitical shifts influence maritime carbon pricing policies, by employing up-to-date shipping data, emission standards, and realistic transshipment and routing configurations to quantify the

environmental externalities associated with rerouted vessels. The study evaluates carbon leakage risks through frequency analysis and conditional probability, shedding light on the transshipment probabilities for various container ship types. This research has two main objectives. First, it categorizes rerouted container shipping routes by origin and destination, analyzing increases in greenhouse gas (GHG) emissions to evaluate the environmental impact of bypassing the Cape of Good Hope. Second, it examines routes with the highest emission increases—especially those connecting East Asia and the Middle East to Europe—to assess their potential risks to the EU's maritime carbon pricing system. With a rise of more than 75%, the Middle East-Europe route saw the largest increase in journey duration. There were increases of between 23% and 42% in the number of journeys leaving from and arriving at Singapore, the center for Southeast Asia, most likely as a result of the dilution effect of already enormous distances. Under the assumption that there is no unexpected acceleration or deceleration and that the average journey speed remains constant, the length of the voyage leads to a linear rise in fuel consumption and greenhouse gas emissions. About 42% of all rerouted container ships were directly connected to the European Economic Area (EEA) or within its 300 nm radius, according to the data preprocessing results. This highlights how closely the Red Sea shipping situation and the European Union economy are related.

The Houthi attacks in the Red Sea region pose a significant risk of environmental pollution, particularly through potential oil spills and maritime accidents. These attacks often target vessels carrying oil and other hazardous cargo, increasing the likelihood of spills that can have devastating effects on marine ecosystems. An oil spill in this region would not only threaten marine biodiversity but also damage coastlines (IMO, 2024). Additionally, the use of explosive devices and the resulting fires can release pollutants into the air and sea, contributing to a broader environmental degradation. The increased risk of pollution from these attacks underscores the need for enhanced maritime security and preventative measures to protect the fragile marine environment in the Red Sea.

The increase in carbon pricing has prompted shipping companies to explore strategies for reducing compliance emissions. According to Peng et al. (2024) one such strategy involves relocating transshipment operations, which entail transferring cargo between vessels at intermediary ports en route to the final destination. This process differs from a standard port stop, which serves various logistical functions while cargo remains on

the same vessel. By shifting transshipment activities from areas subject to the Emissions Trading System (ETS) to nearby regions that fall outside its jurisdiction, companies can effectively obscure their overall maritime emissions. Under the EU-ETS, only emissions from transshipment points within ETS-compliant areas are considered in the carbon pricing framework. For instance, in a typical rerouted emission compliance scenario, containers are initially loaded onto a vessel at the port of origin, such as Singapore. The vessel then proceeds to a transshipment hub, like Durban, where the containers are temporarily stored before being transferred to another vessel. This second vessel transports the containers to their final destination, such as Rotterdam. According to EU-ETS regulations, 50% of the emissions from the leg of the journey from Durban to Rotterdam are counted, while emissions from the initial leg from Singapore to Durban are excluded. When companies employ this transshipment strategy to evade carbon pricing, it is referred to as "carbon leakage."

If military tensions in the Red Sea persist into 2025, the EU Emissions Trading System (ETS) will cover 70% of international route emissions. The analysis of carbon leakage risk for 2025 emphasizes the significant influence of carbon emission compliance on transshipment behavior. (Peng, et al., 2024)

The direct and indirect environmental effects of rising maritime traffic and fuel consumption linked to Houthi actions in the Red Sea are considerable and complex. Directly, the extra fuel burnt by ships on longer routes and experiencing delays increases carbon emissions, worsening the already large environmental impact of global shipping. Additionally, this surge in fuel use leads to higher emissions of sulphur and nitrogen oxides, which contribute to air pollution and related health risks, especially in coastal regions. The increased risk of maritime conflicts and navigational issues raises the chances of oil spills, which can severely harm marine environments. Indirectly, rerouting ships to steer clear of conflict zones often leads to higher maritime traffic in previously less travelled areas, potentially disrupting local marine ecosystems and wildlife. Additionally, the greater fuel demands of longer journeys contribute to the depletion of fossil fuel resources, putting further pressure on these already limited natural assets. Together, these direct and indirect environmental impacts highlight the importance of incorporating ecological considerations into discussions about maritime security and regional conflicts. (E. Rodriguez-Diaz, et al., 2024)

6. METHODOLOGY

In order to effectively examine the research questions and gather relevant data for analysis, this thesis employs a questionnaire as a primary research methodology. Questionnaires are a widely accepted tool for collecting quantitative and qualitative data, offering flexibility and accessibility. By distributing a structured set of questions, it becomes possible to gather diverse perspectives from a big sample of respondents, allowing for both statistical analysis and the interpretation of nuanced responses. According to Patten L. (2016) another advantage, is the anonymity which allows the participants to express their true opinion. This approach allows for the gathering of various perspectives on how geopolitical risk affect freight market by professionals from the shipping sector. All participants were informed regarding the purpose of the research and participated voluntarily with their consent. Anonymized data collection was used to guarantee the confidentiality of the responses, and no personally identifiable information was saved. However, the questionnaire most of the time does not contain in depth analysis and context regarding the research in field, in comparison with an interview .

The questionnaire was made via Google Forms and handed via email and links to the participants. It is divided into two sections: the first focused on demographic data and the second on respondents' perceptions and practices regarding the effects of geopolitical risks in the freight market. A combination of Likert scale questions, multiple-choice questions, and open-ended responses were used to provide a comprehensive view of the respondents' perspectives. In total there were 17 questions from which 5 were demographical, 7 Likert scale questions (Vagias & Wade, 2006), 4 multiple choice and 1 open-minded. The questionnaire was studied and approved by my supervisor in order to ensure clarity and relevance.

The target population consisted mainly of professionals working in the maritime shipping industry. A convenience sampling method was employed. A total of 68 responses were collected, which is a sufficient sample. The questionnaire was created and distributed online using Google Forms to guarantee respondents from different places have easy access. Invitations to participate were sent via email and social media platforms. The survey remained open for a period of 10 days.

The data collected from close-ended questions were analyzed with the use of SPSS, where descriptive statistics such as mean values and frequency distributions were calculated. Meanwhile, the answers from the open-minded question were gathered and categorized in order to study the patterns. This approach, which combines both quantitative and qualitative data, contributes into grasping a more spherical idea about the participants' perspectives.

Although the questionnaire yielded insightful information, it is important to recognize that the sample may not be fully represantive of the entire population due to the use of convenience sampling.

In summary, the selected research methodology was sufficient and effective in gathering large-scale data on how geopolitical risks affect the shipping market. Despite its limitations, the questionnaire provided valuable data regarding the professionals' perspectives and ways of action.

7. ANALYSIS IN RESULTS

The following section presents the results obtained through SPSS analysis, examining key variables such as age, gender, company type, position and years of experience. Descriptive statistics, including medians, were calculated to summarize the data. Additionally, non-parametric tests, such as the Mann-Whitney U and Kruskal-Wallis tests, were conducted to assess differences between groups. Significance levels (p-values) are reported to highlight statistically meaningful findings. These results provide insights into the relationships and trends observed across the sample regarding the impact of geopolitical in freight market and the effects of the Red Sea crisis in the container market.

		AGE	GENDER	COMPANY TYPE	COMPANY POSITION	YEARS OF EXPERIENCE
N	Valid	68	68	68	68	68
	Missing	0	0	0	0	0
Median		2,00	2,00	1,50	2,00	2,00

Table 1 Demographic Data

The statistics *Table 1* summarizes data related to a sample of 68 individuals across five categories: age, gender, company type, company position, and years of experience. The summary gives us the number of valid entries for each category, confirms that there are no missing data points, and provides the median for each category. The median shows the central tendencies of the sample.

Specifically, since median for age is 2 this means that the majority of the respondents are included in the second age group (26-35 years old). The median 2 is also seen for gender (female), company position (senior position) and years of experience (6-10 years). The majority of the variables have median of 2, expect from company type which has 1.5. This indicates that median value falls between category 1 (shipping management company) and category 2 (forwarding company). Based on these median values, the majority of the sample seem to be female, between 26 to 35 years old mid-level in their positions, working mostly for either o shipping management company or a forwarding company and in a relatively early stage in their careers.

N	Valid	68	68	68	68	68	68	68	68	68	68	68
	Missing	0	0	0	0	0	0	0	0	0	0	0
Median		6,00	6,00	6,00	6,00	6,00	6,00	6,00	5,00	5,50	5,00	5,00

Table 2 Perception of respondents on the impact of geopolitical risk

Table 2 provides median values for the Likert style questions, each with 68 valid responses and no missing data. The median for the first 7 questions is consistently 6, indicating a trend of positive sentiment, whereas 3 questions have a median of 5, showing a slightly more neutral or moderate response. Also, one question has a median of 5.50.

The consistency across these questions indicates a strong consensus or alignment in responses. The median of 6 suggests that respondents lean towards agreeing that geopolitical risks usually affect freight market and that the crisis in Red Sea has significant impact on the container ship market. This belief is aligned with the current researches and bibliography available. As established before, geopolitical risks such as war and economic factors play a pivotal in freight shaping and in the shipping industry. For instance, the war between Ukraine and Russia led to vessel rerouting, supply chain disruptions and changes in the worldwide trade. Moreover, it is shown that respondents tend to agree that operational expenses, vessel rerouting and insurance fees are affected the most from geopolitical events. According to the research of Haralambides et al.(2024), geopolitical events and the crisis in Red Sea in particular usually leads to vessel rerouting (in order to minimize risk) and higher insurance fees and premiums, with all these leading to higher operational costs and higher freight rates.

Respodents have a more neutral response regarding the impact of geopolitical risks in gas emissions, since median is 5. Even though, the rerouting has led to higher emissions and increased the environmental footprint, people still believe that GHG emissions are affected in a moderate way by the geopolitical risks. This could occur since other effects like operating expenses or vessel rerouting are more obvious. However, in the article Rodriguez et al. (2024) it is stated that since the route via Cape of Good of Hope is longer the GHG emissions are higher.

Last but not least, as shown in Figure 1Extend in which respondents' company has implemented strategies to mitigate risk by company type most of the companies respondents worked for

have implemented strategies to mitigate risk. The implementation of these strategies varies depending on the specific industry segment and the company's role within the shipping sector. For instance, companies that are directly involved in maritime transport—such as shipping lines, container carriers, and freight forwarders—have been more significantly impacted by these risks compared to those whose involvement in the supply chain is less direct. As a result, the nature and scope of the risk mitigation strategies differ substantially across companies based on their field of expertise and exposure to maritime hazards.These risk management measures have had a noticeable impact on the scheduling and operational costs of shipping companies (Figure 2 Extend in which Crisis in Red Sea affected the company of respondent by company type). To minimize exposure to risk, particularly in regions prone to piracy and geopolitical instability companies have taken specific actions that affect the way they manage shipping routes and vessel operations. Among the most common strategies is the rerouting of vessels to avoid high-risk areas. Although rerouting helps reduce the likelihood of encountering threats, it often leads to longer transit times and increased fuel consumption, which in turn raises operational costs.

Furthermore, operational adjustments also include enhanced security measures and tighter coordination within the supply chain to better manage unforeseen disruptions. This has implications not only for the scheduling of shipments but also for the overall reliability and cost-efficiency of maritime transport. In some cases, shipping companies have had to invest in additional safety equipment, hire security personnel, or provide specialized training for crews to handle potential threats effectively. These precautionary measures contribute to increased operational expenses, adding to the financial burden on shipping companies.

The operational delays and increased costs associated with these risk mitigation strategies are not merely logistical challenges—they also influence broader supply chain dynamics. Longer transit times can lead to disruptions in inventory management, forcing companies to adjust their supply chain strategies to accommodate potential delays. This, in turn, can have a cascading effect on costs and pricing throughout the supply chain, ultimately impacting the end consumers who bear the brunt of increased transportation expenses.

The data reveals that the majority of respondents report experiencing only slight changes, or no substantial alterations at all, in their relationships with business partners. This suggests that, at present, the events or factors under consideration—whether geopolitical disruptions, market changes, or other external factors—have not had a profound or lasting effect on the dynamics of partnerships within the industry.(Figure 3).

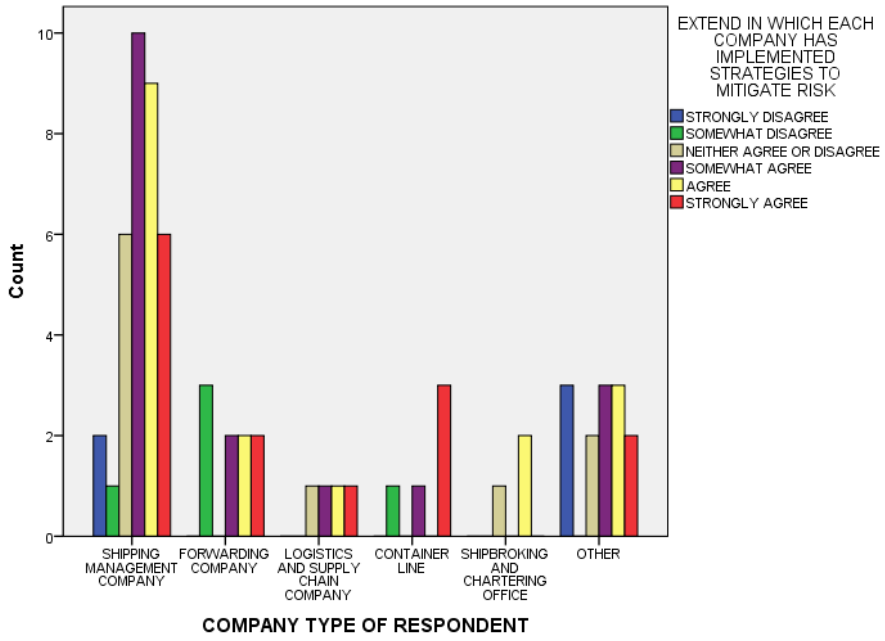

Figure 1Extend in which respondents' company has implemented strategies to mitigate risk by company type

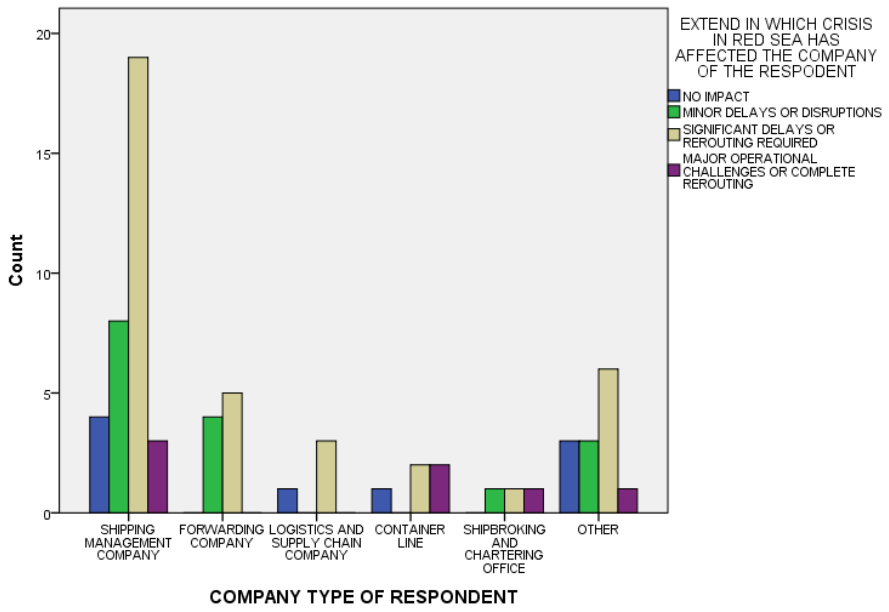

Figure 2 Extend in which Crisis in Red Sea affected the company of respondent by company type

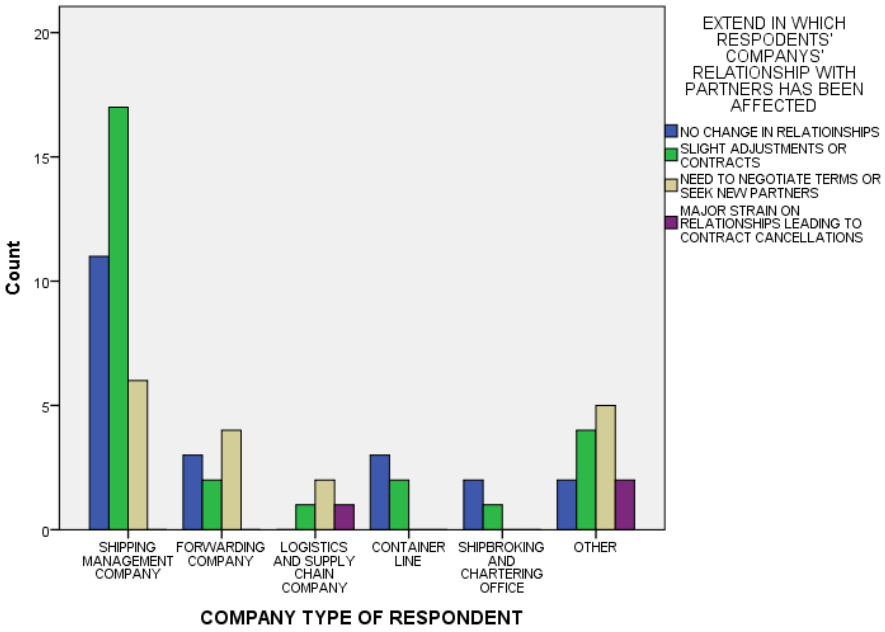

Figure 3 Extend in which respondents' company relationship with partners has been affected by company type

TEST STATISTICS												
Mann-Whitney U	546	568	538,5	462	530,5	556,5	546	546	457,5	522	514	518
Wilcoxon W	1107	1198	1168,5	1023	1091,5	1186,5	1107	1107	1087,5	1152	1144	1079
Z	-0,411	-0,123	-0,515	-1,478	-0,59	-0,265	-0,408	-0,408	-1,548	-0,72	-0,0807	-0,76
Asymp. Sig. (2-tailed)	0,681	0,902	0,607	0,139	0,555	0,791	0,683	0,683	0,122	0,471	0,42	0,448

Table 3 Mann Whitney - U statistics on perception of respondents' regarding the impact of geopolitical risk by gender

Σφάλμα! Το αρχείο προέλευσης της αναφοράς δεν βρέθηκε. includes results for a Mann-Whitney U test applied to all questions comparing the responses of males and females. Across all questions, the p-values are all greater than 0.05, indicating that there are no statistically significant differences between male and female responses for any of the questions. The closest to significance is in question 3 regarding whether geopolitical risks have significantly disrupted global container trade ($p = 0.139$), where females have slightly higher mean ranks (37.80) compared to males (31.00), but this difference is still not statistically significant. More specifically, women tend to agree more that geopolitical risks have significantly disrupted the global container trade, whereas men tend to agree less strongly. Moreover, males support that vessel rerouting is highly affected by geopolitical risk, while women tend to agree in more moderate way. This is shown since the mean ranks of males (38.14) are higher than those for females (31.07).However, the p-value of 0.122 is greater than 0.05, so there is no statistically significant difference in responses.

The results of the Mann-Whitney U test indicate that gender does not have a statistically significant impact on the responses to the survey questions. Specifically, the analysis reveals that the differences in the mean ranks between male and female respondents are minimal and fail to reach statistical significance. This suggests that gender does not play a prominent role in shaping respondents' perceptions or attitudes toward the topics under investigation in this study.

Nonetheless, geopolitical risks indeed result in global supply chain disruptions by introducing uncertainties that affect the stability and efficiency of global trade networks. These risks, such as trade wars, military conflicts, and sanctions, can result

in abrupt shifts in supply and demand, create barriers to the free movement of goods, and impose regulatory complexities on international transactions. According to Gary Gereffi and Karina Fernandez-Stark (2016), such disruptions may lead to delays, increased costs, shortages of critical materials, or complete cessation of trade routes, forcing companies to alter their sourcing strategies, invest in alternative logistics. Furthermore, these risks often undermine the predictability required for effective inventory management, forecasting, and long-term strategic planning, ultimately threatening both the resilience and profitability of firms integrated into a global supply chain.

Test statistics															
Chi-Square	4,024	1,578	5,904	1,781	7,765	4,072	3.748	9,374	6,021	8,034	14,470	9,072	,888	1,420	5,063
df	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Asymp. Sig.	,403	,813	,206	,776	,101	,396	,441	,052	,198	,090	,006	,059	,926	,841	,281

Table 4 Kruskal-Wallis Test on perception of respondents' regarding the impact of geopolitical risk by age

Table 4 Kruskal-Wallis Test on perception of respondents' regarding the impact of geopolitical risk by agecontains results from a Kruskal-Wallis test, which is a non-parametric method used to compare differences between more than two independent groups—in this case, the age groups and their responses to the questions. Even though the p-values for all questions indicate that there is not any significance, the younger age group (18-25 years old) and the older age group (45-55 years old) have higher ranks compared to middle aged groups regarding the significance of geopolitical risk in the disruption of global container trade. This shows that respondents from age group 1 and age group 4 think that geopolitical risks such as sanctions or conflicts have significantly disrupted the global container trade, whereas age groups 2 and 3 think that level of disruption is lower. Although there are some visible differences in mean ranks, especially for the over-55 group, these differences are not large enough to be statistically meaningful.

This result could imply that while there may be some underlying differences in how various age groups perceive global issues such as geopolitical risks, the evidence does not support a strong enough claim to distinguish their responses definitively. It is also important to note that the Kruskal-Wallis test is sensitive to differences in the distribution of responses, and while the mean ranks suggest a trend, they do not provide definitive evidence of a significant difference in perceptions between the groups.

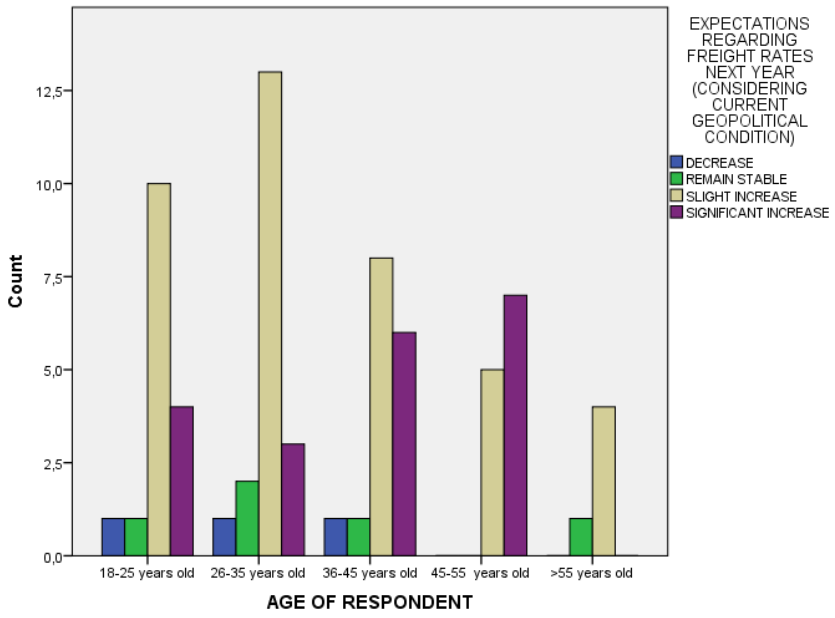

Figure 4 Expectations of respondents regarding freight rates in the next year by age

The p-value of 0.059 that appears in the section regarding forecasts for freight next year, is borderline significant. It suggests that there might be a difference in responses based on age, but it doesn't quite meet the typical 0.05 threshold for statistical significance. As seen in **Σφάλμα! Το αρχείο προέλευσης της αναφοράς δεν βρέθηκε.**, the age group of 45-55 years old has the highest mean rank, which indicates that they believe that freight rates will increase in the next year given the current crisis in Red Sea. However, the group of over 55 years old believes that freight rates will either remain stable or decrease. According to the report published by Flexport (2024), the shipping rates will continue to increase during peak times in 2025. Despite the fluctuation of freight rates and the unstable situation in the Red Sea the overall capacity and demand are expected to rise. The respondents that belong to the age group of 45-55 years old, have enough years of experience and knowledge to predict how the fright

market will respond in the next year and this is the reason that are aligned with current predictions and research. They have experienced geopolitical crises before for instance sanctions in Venezuela and can make forecasts regarding the situation in 2025 more easily and accurately.

In conclusion, while the age-related differences in freight rate forecasts are marginally significant, they suggest that experience and historical context play a key role in shaping perceptions of future market conditions. Further research could explore these trends in more depth, potentially focusing on the specific factors that influence older respondents' predictions and how these factors compare to the views of younger generations.

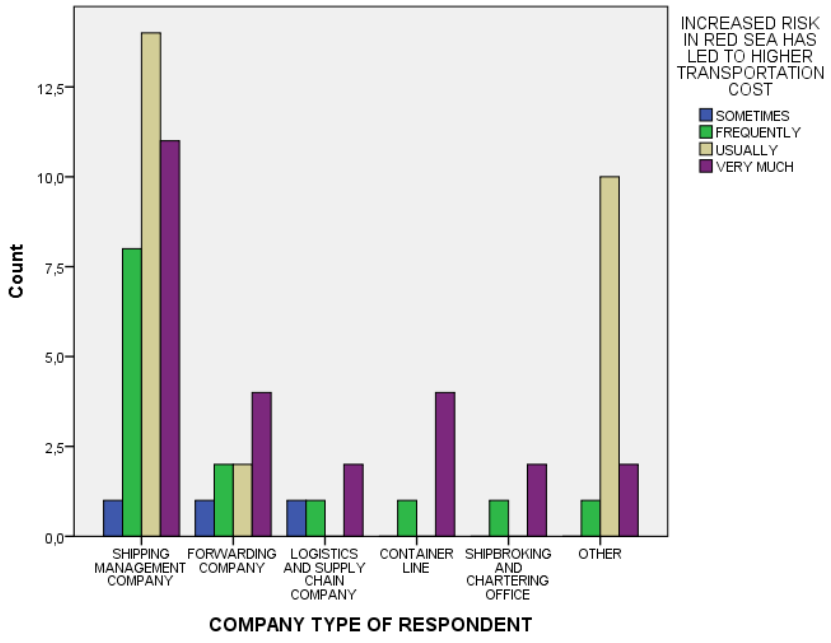

Figure 5 Extend in which increased risk in Red Sea has led to higher transportation cost by company type

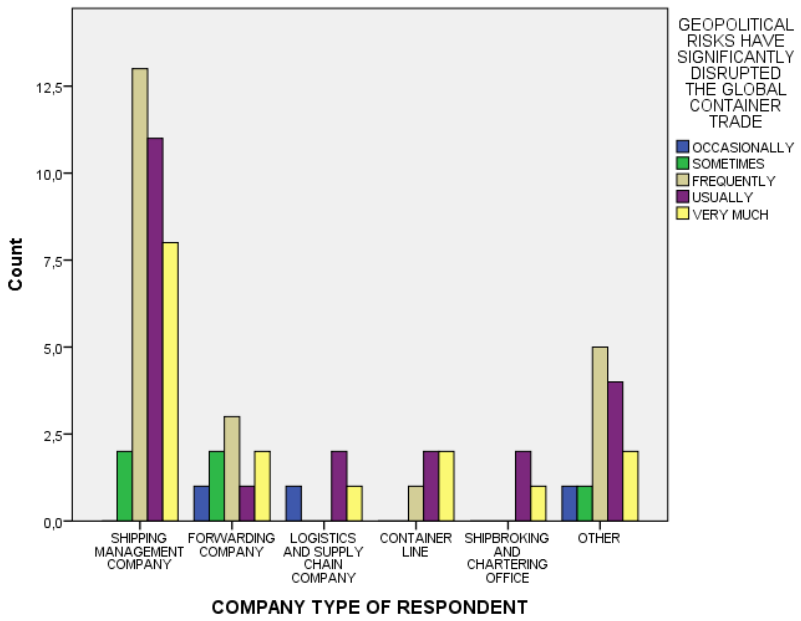

Figure 6 Extend in which geopolitical risks have significantly disrupted the global container trade by company type

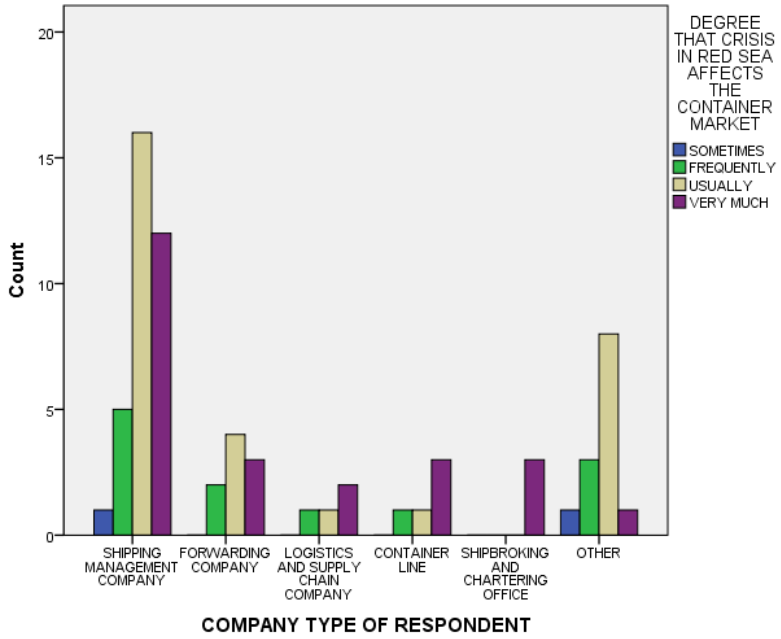

Figure 7 Extend in which crisis in Red Sea affects the container market by company type

The analysis of the survey data reveals a strong consensus among respondents, regardless of the type of company they work for, regarding the impact of geopolitical risk on the freight market, particularly with respect to the ongoing crisis in the Red Sea. One of the most striking findings of the analysis is the unanimous agreement among respondents that geopolitical events—such as wars, conflicts, and international sanctions—have a significant impact on the freight market.

The freight market, driven by the principles of supply and demand, is highly sensitive to geopolitical disruptions. A war or conflict, for instance, can lead to disruptions in the supply chain, affecting both the demand for goods and the ability to transport them efficiently. As a result, freight rates are directly influenced by these geopolitical shifts, with higher demand and constrained supply often leading to increased transportation costs. The respondents also tend to think that crisis in Red Sea has had a significant effect on the transportation of containers (Figure 7 Extend in which crisis in Red Sea affects the container market by company type. People who work in shipbroking and chartering offices are noticeably adamant that current geopolitical events in the Suez Canal have disrupted the container trade. Due to their expertise in the field, they have seen firsthand how these events affect not only the route of container ships, transit time and operating expenses but also the supply chain disruptions that come along.

Additionally, they tend to agree that current geopolitical risks have significantly disrupted the global container trade and that the increased risk in Red Sea has led to higher transportation cost (Figure 5 Extend in which increased risk in Red Sea has led to higher transportation cost by company typeand Figure 6 Extend in which geopolitical risks have significantly disrupted the global container trade by company type). The increasing instability in this region has directly affected transportation costs, with the heightened risks leading to rerouted shipments, longer transit times, and consequently, higher shipping costs. This is consistent with the findings of Dunn and Leibovici (2024), who highlighted the extent to which the crisis in the Red Sea has influenced freight rates, particularly in key shipping corridors like the Suez Canal.

The Suez Canal, as one of the most vital shipping lanes for global trade, has been a focal point for respondents when discussing the impact of the Red Sea crisis. Respondents emphasized the ripple effects of disruptions in this region, which extend far beyond immediate route changes to encompass broader supply chain challenges. As such, the widespread agreement on this point underscores the importance of the Red Sea as a critical zone in global container shipping and highlights the direct link between geopolitical instability and increased transportation costs.

A notable finding from the analysis is the heightened emphasis placed by respondents working in shipbroking and chartering offices on the impact of geopolitical risks in the Suez Canal. These respondents, due to their expertise and hands-on experience in the shipping industry, are particularly vocal about the disruptions caused by geopolitical events. This group of respondents understands the operational and logistical challenges that arise when geopolitical risks force changes to shipping routes.

In conclusion, the survey data indicates a strong consensus among all respondents regarding the disruptive impact of geopolitical risks, particularly in the Red Sea, on the global container trade. The alignment of opinion across different sectors of the shipping industry reinforces the idea that geopolitical risks—whether through direct conflict, sanctions, or other forms of instability—can significantly affect the freight market. The rising transportation costs due to the current crisis in the Red Sea, as indicated by the respondents, support existing literature, such as the research by Dunn and Leibovici (2024), which demonstrates the extent of these disruptions.

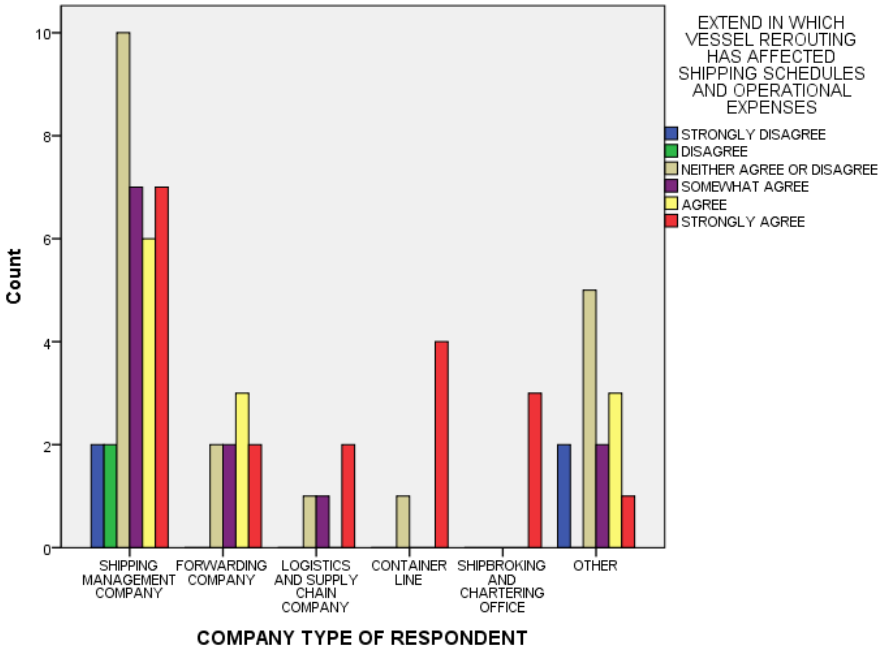

Figure 8 Extend in which vessel rerouting has affected shipping schedules and operational expenses by company type

The p-value of 0.028, as presented in the analysis, indicates a statistically significant difference in how different company types perceive the impact of vessel rerouting on shipping schedules and operating expenses. This finding highlights that the way companies in the shipping industry manage and respond to rerouting decisions can vary significantly based on the specific nature of their business operations. The responses to this question, as illustrated in Figure 8 Extend in which vessel rerouting has affected shipping schedules and operational expenses by company type, show that employees from shipbroking and chartering offices report the highest mean ranks, while respondents from other types of companies tend to report lower ranks.

Shipbroking and chartering offices are also directly engaged in the logistical and financial aspects of shipping operations, meaning that they are more likely to experience the immediate consequences of rerouting decisions. As a result, the employees in these offices are likely to have a heightened awareness of how such disruptions impact both scheduling and costs. This is reflected in their stronger agreement with the statement regarding vessel rerouting and its effect on shipping operations. On the other hand, respondents from other types of companies, such as logistics firms, port operators, or freight forwarders, report lower ranks. This can be explained by the fact that these companies may not be as directly involved in the day-

to-day management of vessel routes or may not experience the same level of operational disruption when routes are altered.

This significance underscores the importance of understanding how different sectors within the shipping industry perceive and respond to geopolitical risks. It highlights that while vessel rerouting is a common risk mitigation strategy, its operational impact is felt more acutely by certain company types, particularly those involved in ship management and chartering.

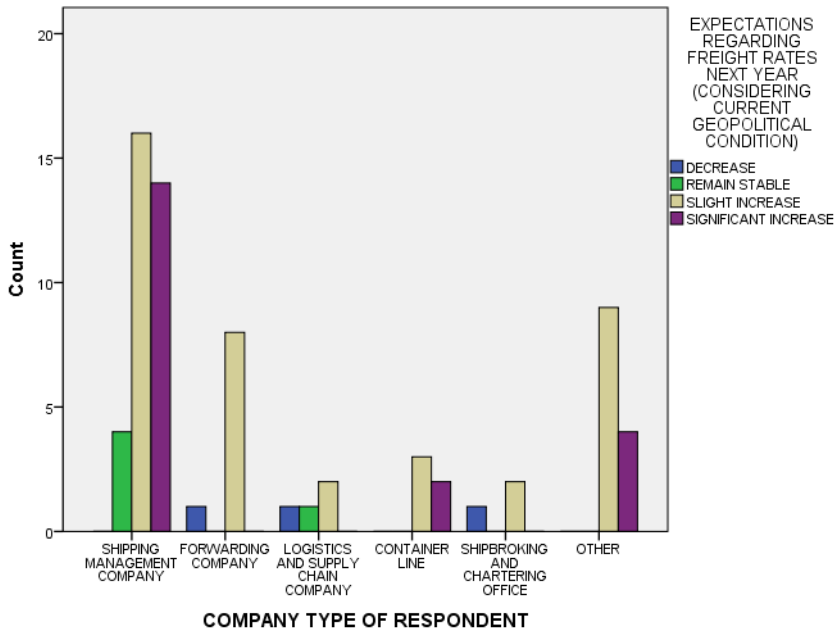

Figure 9 Expectations of respondents regarding freight rates in the next year by company type

In the expectations of respondents regarding freight rates in 2025, there is a p-value of 0.041. In Figure 9 Expectations of respondents regarding freight rates in the next year by company typeit is shown that the container line group employees suggest that freight rates will increase next year. This suggests that those directly involved with managing container shipments see potential factors (like rising demand, costs, or market trends) that could push rates higher. Respondents working in shipping management companies also expect an increase in freight rates. This aligns with the view of the container line group, possibly due to similar market insights or exposure to shipping costs and trends. The

expectations from the container line group and shipping management companies are supported by a reference to Flexport's 2024 article, which predicts an increase in freight rates next year. This provides a secondary confirmation that industry professionals and research both anticipate upward trends in pricing. Overall, the analysis indicates that while some professionals foresee an increase in freight rates, those who manage logistics and supply chains are more optimistic about a decrease, likely due to expectations of efficiencies or improvements in the supply chain.

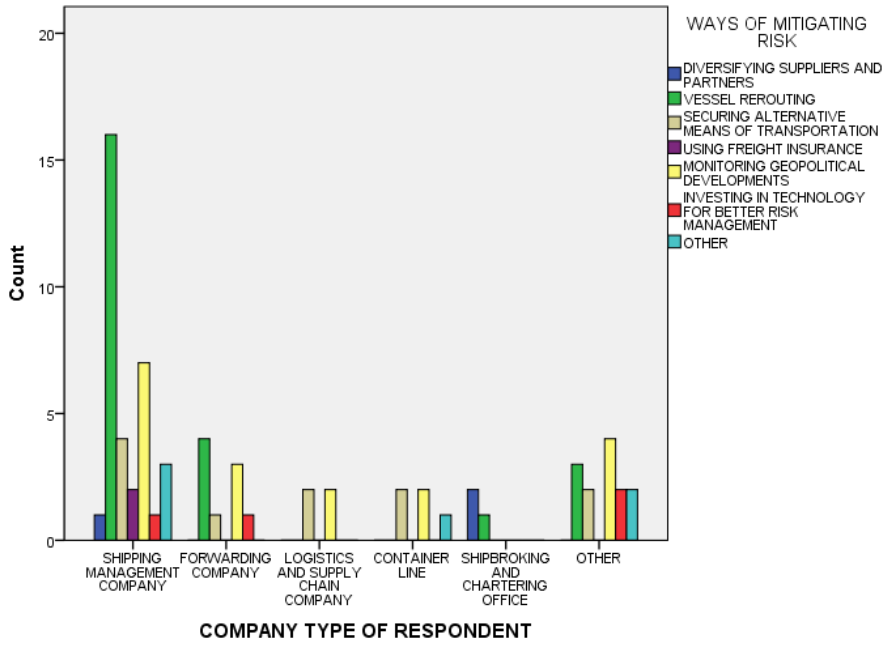

Figure 10 Ways companies of respondents mitigate risk

The data presented in Figure 10 reveals key insights into the risk mitigation strategies employed by companies in the shipping industry, highlighting the varying approaches taken across different company types. The results suggest a multifaceted approach to managing geopolitical risks, with a dominant focus on vessel rerouting as the primary strategy, especially among Shipping Management Companies. Additionally, monitoring geopolitical developments and investing in technology emerge as common practices across a broad range of companies.

The data shows that vessel rerouting is the most frequently selected risk mitigation strategy across multiple company types, with Shipping Management Companies in particular demonstrating a strong preference for this approach. Vessel rerouting involves adjusting shipping routes in response to geopolitical disruptions—such as

conflicts, sanctions, or natural disasters—potentially affecting key trade lanes or chokepoints like the Suez Canal or the Strait of Hormuz. This strategy allows companies to minimize exposure to geopolitical risks by avoiding high-risk areas or taking alternative routes, even if it results in longer transit times or higher operational costs.

Another key risk mitigation strategy that emerges from the data is the widespread practice of monitoring geopolitical developments. This approach is common across nearly all company types, highlighting the growing awareness within the industry of the impact that global political factors can have on the supply chain. Monitoring geopolitical developments involves keeping track of international news, diplomatic relations, trade policies, and any events that could influence shipping routes, regulations, or operational conditions. It indicates that companies are highly aware of the impact of global political factors on the supply chain. Companies are proactive in tracking changes that could influence routes, regulations, or shipping conditions.

Moreover, even though shipping companies show a strong preference towards vessel rerouting there is also a focus on monitoring geopolitical developments and investing in technology, which highlights a mix of adaptive and preventive strategies. This trend suggests that some companies are turning to digitalization and data analytics as tools for improving their risk management capabilities. Investments in technology can encompass a range of solutions, from advanced route optimization software and predictive analytics to real-time data tracking and automated decision-making systems.

The growing emphasis on technology reflects a broader trend towards digital transformation in the shipping industry. By leveraging data analytics and digital tools, companies can gain greater visibility into potential risks, optimize their operations, and make more informed decisions regarding route selection, fuel consumption, and regulatory compliance.

The data implies that resilience and adaptability are key themes in risk mitigation strategies. Companies are not solely relying on traditional, static risk management tactics but are increasingly looking for dynamic responses that can adjust to real-time conditions. The emphasis on Investing in Technology by some companies suggests a growing trend towards digitalization and the use of data analytics for better risk management. Differences between company types highlight that while there are

commonalities, each segment within the industry has unique challenges that shape their risk management priorities.

A central theme that emerges from the data is the focus on resilience and adaptability as essential components of risk mitigation strategies. Companies in the shipping industry are not relying solely on traditional, static risk management practices but are increasingly seeking dynamic, flexible responses to geopolitical risks. The combination of vessel rerouting, monitoring geopolitical developments, and investing in technology demonstrates a growing recognition that risk management in the modern shipping industry requires the ability to adapt quickly to changing circumstances.

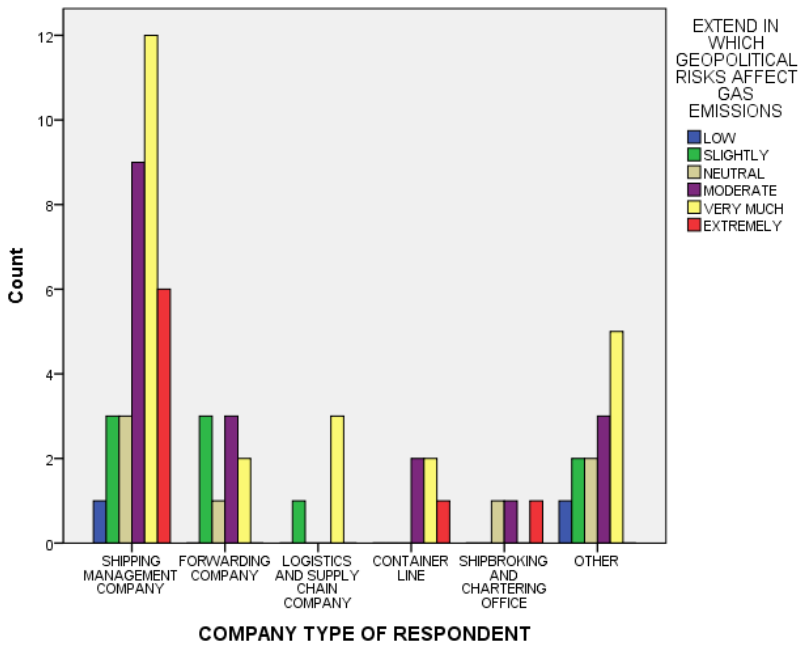

Figure 11 Extend in which Geopolitical risks affect Gas Emissions by company type

The data presented in Figure 11 Extend in which Geopolitical risks affect Gas Emissions by company typereveals a clear divergence in the perceptions of respondents from different sectors regarding the relationship between geopolitical risks and gas emissions in the shipping industry. A significant finding is that respondents working in shipping management companies exhibit a high level of awareness regarding the influence of

geopolitical risks—such as international conflicts, sanctions, and political instability—on fuel availability, pricing, and routing.

The respondents from shipping management companies demonstrate a heightened perception that geopolitical risks have a direct impact on gas emissions. This group, which is closely involved in the day-to-day operations of managing fleets and shipping logistics, likely views geopolitical events primarily through their operational and financial effects. Disruptions in fuel supply chains, changes in fuel pricing, and alterations to shipping routes are among the most immediate consequences they face when geopolitical instability occurs.

In contrast, respondents from other sectors of the shipping industry exhibit a more mixed perception regarding the impact of geopolitical risks on gas emissions. While some acknowledge that geopolitical events can affect fuel availability and routing, they do not consistently view these risks as a primary driver of gas emissions. For these respondents, the relationship between geopolitical events and emissions may appear less direct or less influential compared to other factors such as technological advancements in fuel efficiency, regulatory pressures, or broader market trends. This variation in perception could stem from the respondents' professional roles, which might be more focused on areas such as finance, marketing, or logistics, where the operational consequences of geopolitical risks on fuel emissions are less immediately apparent. UNCTAD (2024) reports that rerouting shipping routes from the Suez Canal to the Cape of Good Hope leads to a significant environmental and economic impact, with greenhouse gas emissions for a round trip between Singapore and Northern Europe increasing by 70%. Additionally, this detour results in a 40% rise in average fuel costs, highlighting the substantial consequences of longer travel distances on both emissions and operational expenses.

While this research focuses primarily on the operational and economic effects of geopolitical risks, it is worth acknowledging the broader environmental implications. Changes in fuel usage, shipping routes, and operational efficiency in response to geopolitical events are factors that contribute to the shipping industry's overall environmental footprint, particularly in terms of GHG emissions. This broader environmental impact, while not the focus of the present study, is an important consideration for future research in the field.

8.RECOMMENDATIONS

Geopolitical issues, including the continuing situation in the Red Sea, are posing significant problems for enterprises in the shipping and freight industry, according to the data analysis. These hazards directly affect shipping prices, the international container trade, and the day-to-day operations of logistics firms. In order to assist businesses in successfully navigating through this complicated environment, some suggestions have been developed.

To begin with, vessel rerouting has been proven to be a frequently and effective risk mitigation technique, businesses should keep improving their rerouting procedures to lessen exposure to geopolitical hotspots. Advanced route planning software should be utilized to optimize fuel consumption and minimize additional travel costs due to rerouting. Rerouting is an important tactic, but businesses shouldn't depend on it exclusively. Layered protection against unforeseen interruptions can be achieved by including extra measures such as securing geopolitical information services and expanding insurance coverage for high-risk routes. Additionally, enhancing decision-making processes can be achieved by investing in technology for data analysis, real-time monitoring, and predictive analytics. Tools like AIS (Automatic Identification System) tracking, satellite-based risk alerts, and fuel consumption monitoring can enable companies to adapt to shifting geopolitical landscapes dynamically.

Considering the relationship between extended routes and heightened operational costs, it is imperative for companies to focus on investments in more fuel-efficient vessels and alternative energy sources. Innovations such as slow steaming, alongside the adoption of Liquefied Natural Gas (LNG) as a substitute fuel, offer viable strategies to counteract escalating fuel expenses. Furthermore, enhancing scheduling flexibility, optimizing load management, and strengthening communication with logistical partners are critical measures for minimizing the impact of disruptions. For container shipping lines specifically, establishing strategic partnerships with freight forwarders can facilitate risk-sharing and bolster overall resilience in the face of geopolitical and economic uncertainties.

Furthermore, shipping companies should closely monitor the changing environmental standards influenced by geopolitical developments. Adhering to International Maritime Organization (IMO) regulations concerning greenhouse gas emissions and minimizing

environmental impact can offer a significant competitive edge. Given the environmental consequences associated with rerouting and increased fuel usage, it is crucial for companies to integrate sustainable practices. This includes implementing carbon offset initiatives and investing in environmentally friendly technologies. Such efforts not only help to comply with regulatory demands but also meet growing market expectations for sustainability.

Maintaining transparent communication with customers and partners about potential delays and increased costs due to geopolitical events can foster trust. Offering flexible service options, such as multiple delivery modes, can accommodate varying customer needs during times of disruption.

It is crucial to keep a close eye on geopolitical developments. Businesses should use consulting services or assign specialised teams to do geopolitical risk assessments. To inform strategic planning, these groups ought to generate projections and reports on a regular basis. Apart from that, it would be useful to implement flexible contract terms with clients to manage financial risks. This will be helpful in case a rise in freight rates due to geopolitical factors occurs and is accompanied by price fluctuations.

Last but not least companies, particularly container lines, should be prepared to increase capacity during anticipated peak times, as forecasted by industry research, to capture market opportunities while managing costs efficiently.

By implementing these recommendations, companies can enhance their resilience to geopolitical risks, mitigate operational disruptions and manage costs effectively. These strategies are not only about responding to current challenges but also about proactively shaping the future of the freight and shipping industry in an uncertain global environment.

9. SIGNIFICANCE AND IMPLICATIONS

The findings of the study underscore the substantial impact of geopolitical risks on the freight and container shipping markets, particularly with regard to the recent crisis in the Red Sea. To the best of our knowledge based on the literature review there is not another available research that highlights how geopolitical risks affect the freight market and how the crisis in Red Sea has affected the container trade up to now. Since the crisis in Red Sea is still ongoing the implications could be fully grasped only after the end of it. The analysis reveals significant patterns and industry trends, providing several key implications and highlighting the importance of strategic adaptations for companies operating within the maritime industry.

The data indicates a growing responsiveness among companies in the maritime industry, particularly those involved in shipping management and container shipping, to geopolitical risks. One prominent strategy for mitigating these risks is the rerouting of vessels, which has become a key approach to managing potential disruptions. This shift highlights a broader trend in the industry toward more adaptable and flexible operational strategies in response to political and economic instability. For instance, the frequent rerouting of vessels in response to crises, such as the disturbances in the Red Sea, demonstrates a proactive effort to protect assets and maintain operational efficiency. This trend of increased adaptability holds significant implications for the long-term sustainability of the maritime sector. Companies must navigate the complex trade-off between effectively managing risk and maintaining operational efficiency, ensuring that their risk management strategies do not unduly impact their cost structures or operational performance.

Moreover, it is stated that geopolitical tensions have a direct influence on freight rates, with industry experts anticipating an increase in costs over the upcoming year. This forecast is consistent with broader economic projections indicating that global instability will likely drive up demand and expenses within the maritime sector. Notably, respondents with greater industry experience, particularly those in older age groups, tended to be more aligned with these predictions, suggesting that a higher level of expertise may offer a strategic advantage in forecasting and decision-making. Accurate freight rate forecasting is essential for effective logistics planning, ensuring

financial stability, and maintaining competitive pricing. A thorough understanding of these economic trends enables companies to make well-informed decisions regarding investments, contracts, and pricing strategies.

The analysis underscores that geopolitical risks are perceived to have varying effects on greenhouse gas (GHG) emissions, with shipping management companies identifying these risks as a key consideration. A particularly significant impact arises from route modifications, which often lead to longer travel distances and consequently higher emissions. For example, the diversion around the Cape of Good Hope has resulted in considerable increases in both emissions and operational costs, illustrating the environmental consequences of rerouting vessels. The findings highlight the environmental trade-offs that come with managing geopolitical risks, stressing the need for the maritime industry to adopt more sustainable practices. Shipping companies are increasingly challenged to balance the immediate need for operational security with the long-term goal of environmental sustainability. This requires a greater commitment to investing in eco-friendly technologies, alternative fuels, and carbon offsetting measures to reduce the environmental impact of such geopolitical adjustments.

Another result from this research, is that geopolitical risks play a major role in disrupting global container trade, with the responses from various companies, regardless of size or demographic, showing a consistent acknowledgment of this impact. In particular, the escalating risks in the Red Sea have significantly influenced both transportation costs and overall market stability. This observation supports existing academic literature, reinforcing the validity of the study's findings. These disruptions demand a reassessment of global trade routes and supply chain dependencies, encouraging companies to diversify their logistics strategies. Additionally, the findings highlight the growing need for improved predictive models and data analytics to better anticipate and adapt to geopolitical shifts. Companies that invest in these tools and technologies will likely gain a competitive edge, as they will be better equipped to navigate the complexities of geopolitical uncertainty.

Different company types exhibit distinct risk mitigation strategies. Shipping management companies are more inclined to utilize vessel rerouting, while other sectors, such as container lines, place emphasis on technological investments and monitoring geopolitical developments. This diversity of strategies indicates that there

is no one-size-fits-all solution; companies must tailor their approaches based on their specific roles in the supply chain.

The implications of this study are broad and underscore the need for companies in the maritime industry to implement flexible, industry-specific strategies capable of responding to the dynamic geopolitical environment. The findings are significant as they offer valuable guidance for improving risk mitigation, enhancing predictive forecasting, and fostering environmentally sustainable practices. By incorporating these insights into their strategic planning processes, maritime companies can get a comparative advantage.

10.LIMITATIONS

This study is subject to several limitations that may impact the interpretation of the findings. First, the sample size was relatively small, which could limit the generalizability of the results to a broader population. The research was also conducted within a specific geographic area and context, which may not fully represent different environments or populations. Furthermore, time constraints restricted the depth of analysis, potentially leaving some areas underexplored. One significant constraint is the limited availability of academic sources and reliable data specifically addressing the impact of geopolitical risks, particularly the crisis in the Red Sea, on the container trade and freight market. This scarcity of sources necessitated reliance on industry reports, news articles, and expert opinions.

Additionally, the rapidly changing nature of geopolitical events means that the data used in this study might not fully capture the latest developments, potentially affecting the accuracy of the analysis. Lastly, the complex nature of the global freight market, with its numerous variables and influencing factors, means that isolating the impact of specific geopolitical risks remains challenging, leaving room for further research to explore additional contributing elements. Future studies may address these limitations by expanding the sample size, incorporating additional variables and having more information regarding the impact of Red Sea crisis to the container market (probably when this geopolitical event is concluded).

11.CONCLUSIONS

Geopolitical risks play a pivotal role in shaping shipping freight rates. These type of risks cause numerous delays, longer transit times, supply chain disruptions and freight volatility. The shipping industry, particularly in response to tensions and sanctions, experiences elevated freight costs and operational expenses, likely due to additional routing requirements, port delays, and heightened insurance premiums. Notably, the Red Sea crisis has created bottlenecks in container trade, amplifying the typical impacts of regional crises on global logistics. The findings suggest that certain respondent groups, particularly those in shipbroking, recognize that operational dependencies and cost structures are vulnerable to such crises.

The analysis conducted with the use of the questionnaire highlights that participants perceive geopolitical risks as substantial disruptors in the freight market. The responses also reveal that participants show more moderate views concerning specific risk types, such as greenhouse gas emissions and environmental concerns. This suggests a partial awareness of the substantial risks that environmental challenges are likely to present in the future and the significant extent to which these factors may influence freight markets. Moreover, professionals in shipbroking may view geopolitical risks as more critical, given their position in container trade facilitation and market sensitivity to freight rate fluctuations. As intermediaries, they are uniquely positioned to observe firsthand how shipping companies manage geopolitical risks in response to varying circumstances. While gender and age differences are generally not statistically significant, those involved in shipbroking and chartering are especially cognizant of how regional crises, like those in the Red Sea, lead to tangible disruptions in container flow, pricing, and partnership dynamics.

There is a divergence of opinion between different sectors within the broader logistics and shipping industry. While container line and shipping management entities anticipate rising freight costs, the logistics and supply chain professionals foresee a potential decrease. This suggests that the perception of future market conditions might depend heavily on one's position within the supply chain and the specific challenges or advantages each group faces. Most respondents, who are experts in the field, anticipate that freight rates will rise in 2025, considering the current geopolitical landscape.

Overall, the ongoing crisis in the Red Sea has introduced significant disruptions and irregularities within the container trade industry. Each shipping company and industry professional adopts a distinct approach to address these challenges, as an optimal strategy for managing or circumventing such events has yet to be established. Geopolitical risks have consistently impacted global trade, underscoring the importance of developing effective measures to mitigate their influence or ensure preparedness in confronting these challenges.

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APENDIX A

A1.QUESTIONNAIRE:

Geopolitical risk in Freight market

Welcome
to this study!

Thank you for taking the time to participate in this research, which is being conducted as part of my dissertation for the MSc in Shipping Management at University of Piraeus. The purpose of this survey is to identify how geopolitical risks affect the freight market and the supply chain.

Confidentiality: All responses will be treated as confidential. No personal identifying

information will be collected, and results will be anonymized in any reports or publications. Data will be stored securely and will only be accessible by the researchers. Any personal information is collected for statistical purposes only.

Risks and Benefits: There are no inherent risks or benefits to participating in this study

beyond the contribution you will be making to our research.

Participation and Withdrawal: Your participation in this survey is completely voluntary; you are free to withdraw from the study at any time without any penalty. No

compensation or reimbursement for participation is provided.

The completion of the questionnaire will take no more than 10 minutes.

By proceeding, you are stating that you are at least 18, you have read the terms, and you provide your consent to participate. Please read the instructions for each question carefully,and make sure you have answered all the questions.

Demographic data:

1. **1. Age:** *

- ◯ 18-25
- ◯ 26-35
- ◯ 36-45
- ◯ 45-55
- ◯ >55

2. **2. Gender:** *

- ◯ Male
- ◯ Female
- ◯ Prefer not to say

3. **3. In what type of company do you work for:** *

- ◯ Shipping Management Company
- ◯ Forwarding Company
- ◯ Logistics and Supply Chain Company
- ◯ Container Line
- ◯ Maritime Agency
- ◯ Shipbroking and Chartering Office
- ◯ Other

4. **4. Position inside the company:** *

- ◯ Junior Position
- ◯ Senior Position
- ◯ Manager
- ◯ Stakeholder
- ◯ Owner
- ◯ Other

5. **5. How many years of work experience do you have in this position:** *

- ◯ <5 years
- ◯ 6-10 years
- ◯ >10 years

6. **1. In what degree do geopolitical risks affect the freight market:** *

	1	2	3	4	5	6	7	
Not	◯	◯	◯	◯	◯	◯	◯	Very much

7. **2. In what degree does the crisis in Red Sea affect the containership market:** *

	1	2	3	4	5	6	7	
Not	◯	◯	◯	◯	◯	◯	◯	Very much

8. **3. Geopolitical risks, such as conflicts or sanctions, have significantly disrupted the global container trade.** *

	1	2	3	4	5	6	7	
Stro	◯	◯	◯	◯	◯	◯	◯	Strongly agree

9. **4. The increased risk in the Red Sea region has led to higher transportation costs for container shipments.** *

	1	2	3	4	5	6	7	
Stro	◯	◯	◯	◯	◯	◯	◯	Strongly agree

10. **5. To what extend do geopolitical risk affect the below:** *

	Not at all	Low	Slightly	Neutral	Moderate	Very much	Extremely
a) Operational Expenses	◯	◯	◯	◯	◯	◯	◯
b) Vessel Rerouting	◯	◯	◯	◯	◯	◯	◯
c) Insurance Fee	◯	◯	◯	◯	◯	◯	◯
d) Gas Emissions	◯	◯	◯	◯	◯	◯	◯
e) Access to ports or borders	◯	◯	◯	◯	◯	◯	◯

11. **6. Considering current geopolitical conditions, how do you expect freight rates in the container market to change over the next year:** *

- ◯ Decrease
- ◯ Remain stable
- ◯ Slight increase
- ◯ Significant increase

12. **7. How do you currently mitigate geopolitical risks:** *

- ◯ Diversifying suppliers and partners
- ◯ Vessel rerouting
- ◯ Securing alternative means of transportation (e.g. air freight)
- ◯ Using freight insurance
- ◯ Monitoring geopolitical developments
- ◯ Investing in technology for better risk management
- ◯ Other

13. **8. My company has implemented risk mitigation strategies (e.g., vessel rerouting, insurance, alternative transportation) to face the risks in the Red Sea region.** *

	1	2	3	4	5	6	7	
Stro	◯	◯	◯	◯	◯	◯	◯	Strongly agree

14. **9. My company has had to reroute vessels due to the increased risk in the Red Sea, affecting shipping schedules and operational costs.** *

	1	2	3	4	5	6	7	
Stro	◯	◯	◯	◯	◯	◯	◯	Strongly agree

15. **10. How has the crisis in the Red Sea region affected your company's shipping routes and schedules?** *

- ◯ No impact
- ◯ Minor delays or disruptions
- ◯ Significant delays or rerouting required
- ◯ Major operational challenges or complete rerouting

16. **11. Has the crisis in the Red Sea influenced your company's relationships with shipping partners, such as freight forwarders or carriers?** *

- ◯ No change in relationships
- ◯ Slight adjustments or contracts
- ◯ Need to negotiate terms or seek new partners
- ◯ Major strain on relationships leading to contract cancellations

17. **12.Please provide any additional comments on how geopolitical risks have affected your company's operations.**

APPENDIX B

Tables from statistical analysis:

Test Statistics[a]						
Mann-Whitney U	353,500	364,000	333,000	365,500	298,000	338,500
Wilcoxon W	818,500	829,000	798,000	830,500	763,000	803,500
Z	-,847	-,697	-1,254	-,663	-1,826	-1,092
Asymp. Sig. (2-tailed)	,397	,486	,210	,507	,068	,275

Table 5 Mann Whitney - U statistics on perception of respondents' regarding the impact of geopolitical risk by years of experience

Test Statistics[a]						
Mann-Whitney U	39,000	79,500	68,500	60,500	51,000	60,500
Wilcoxon W	634,000	94,500	663,500	655,500	646,000	655,500
Z	-1,987	-,246	-,749	-1,085	-1,518	-1,056
Asymp. Sig. (2-tailed)	,047	,805	,454	,278	,129	,291
Exact Sig. [2*(1-tailed Sig.)]	,054[b]	,823[b]	,500[b]	,314[b]	,164[b]	,314[b]

Table 6 Mann Whitney - U statistics on perception of respondents' regarding the impact of geopolitical risk by company type

Test Statistics[a]						
Mann-Whitney U	212,000	194,000	206,500	171,500	213,000	202,500
Wilcoxon W	443,000	425,000	437,500	402,500	444,000	433,500
Z	-,222	-,711	-,373	-1,283	-,199	-,464
Asymp. Sig. (2-tailed)	,825	,477	,709	,199	,842	,643

Table 7 Mann Whitney - U statistics on perception of respondents' regarding the impact of geopolitical risk by company position

Test Statistics[a,b]						
Chi-Square	1,564	1,512	5,074	3,212	1,210	1,024
df	2	2	2	2	2	2
Asymp. Sig.	,457	,469	,079	,201	,546	,599

Table 8 . Kruskal Wallis Test on perception of respondents' regarding the impact of geopolitical risk by years of experience

Test Statistics[a,b]				
Chi-Square	8,035	1,917	3,687	8,952
df	5	5	5	5
Asymp. Sig.	,154	,860	,595	,111

Table 9 Kruskal Wallis Test on perception of respondents' regarding the impact of geopolitical risk by company position

Test Statistics[a,b]				
Chi-Square	3,497	,502	4,151	2,126
df	2	2	2	2

Asymp. Sig.	,174	,778	,125	,345

Table 10 Kruskal Wallis Test on perception of respondents' regarding the impact of geopolitical risk by years of experience

Test Statistics[a,b]											
	Q1	Q2	Q3	Q4	Q5A	Q5B	Q5C	Q5D	Q5E	Q8	Q9
Chi-Square	,260	8,979	5,494	2,963	7,928	9,058	10,220	6,244	6,033	2,241	12,530
df	5	5	5	5	5	5	5	5	5	5	5
Asymp. Sig.	,998	,110	,359	,706	,160	,107	,069	,283	,303	,815	,028

Table 11 Kruskal Wallis Test on Perception on the impact of geopolitical risk by company type

APPENDIX C

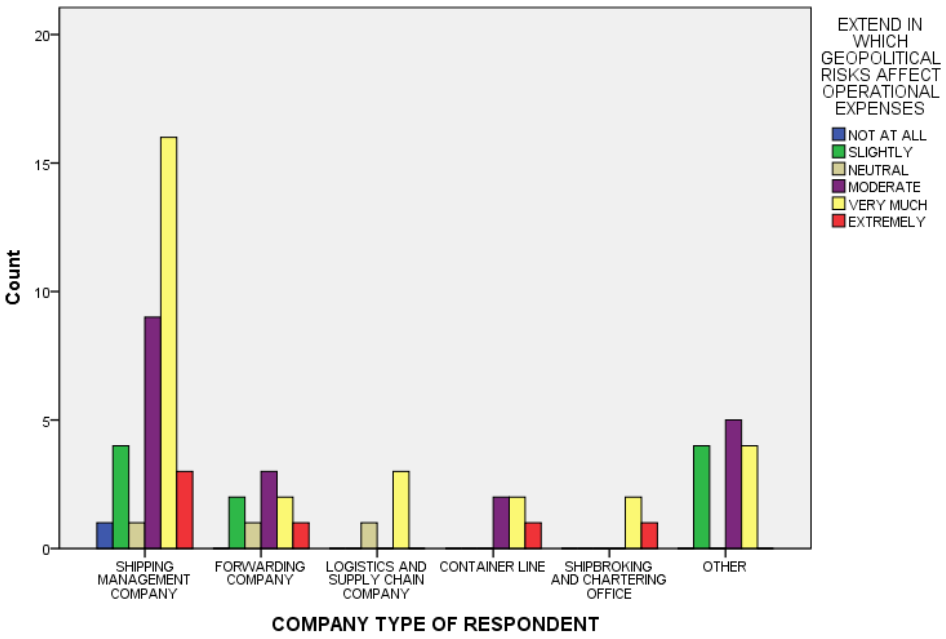

Figure 12 Extend in which geopolitical risks affect operational expenses by company type

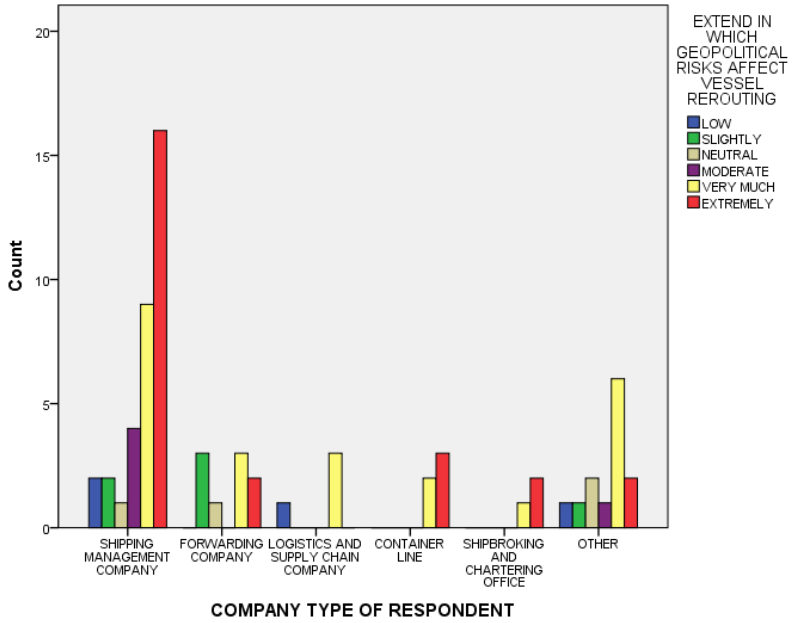

Figure 13 Extend in which geopolitical risks affect vessel rerouting by company type

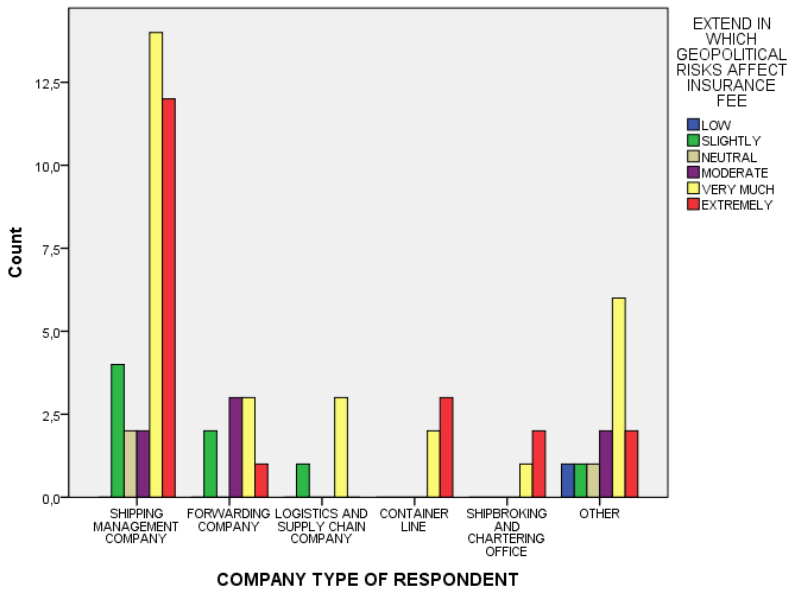

Figure 14 Extend in which geopolitical risks affect insurance fee by company type

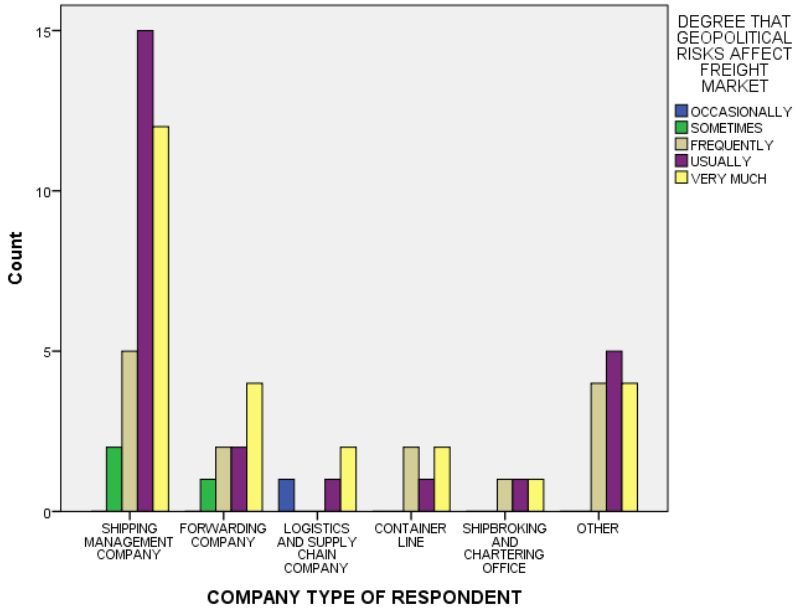

Figure 15 Degree that geopolitical risks affect freight market by company type

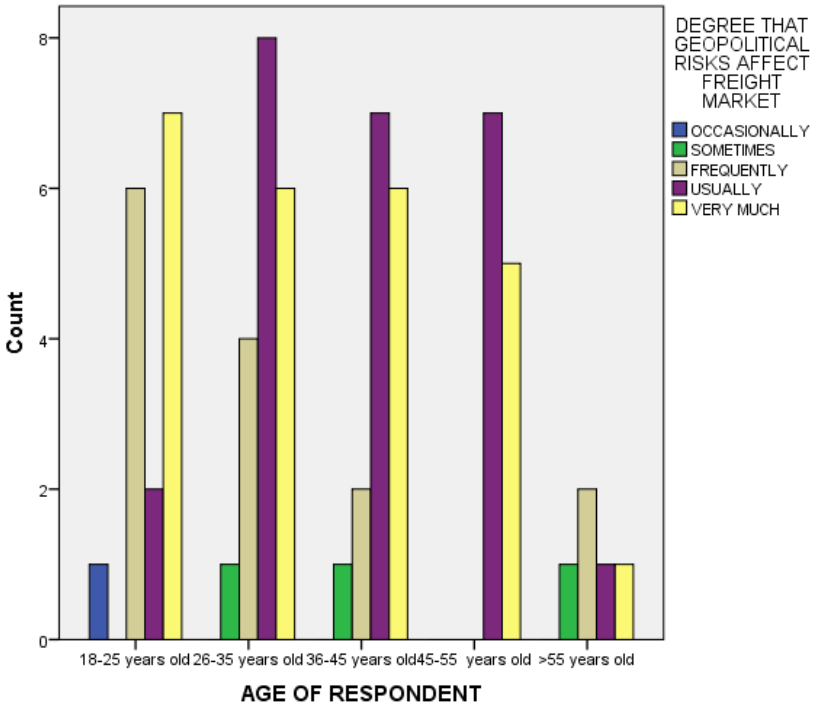

Figure 16 Degree that geopolitical risks affect freight market by age of respondent

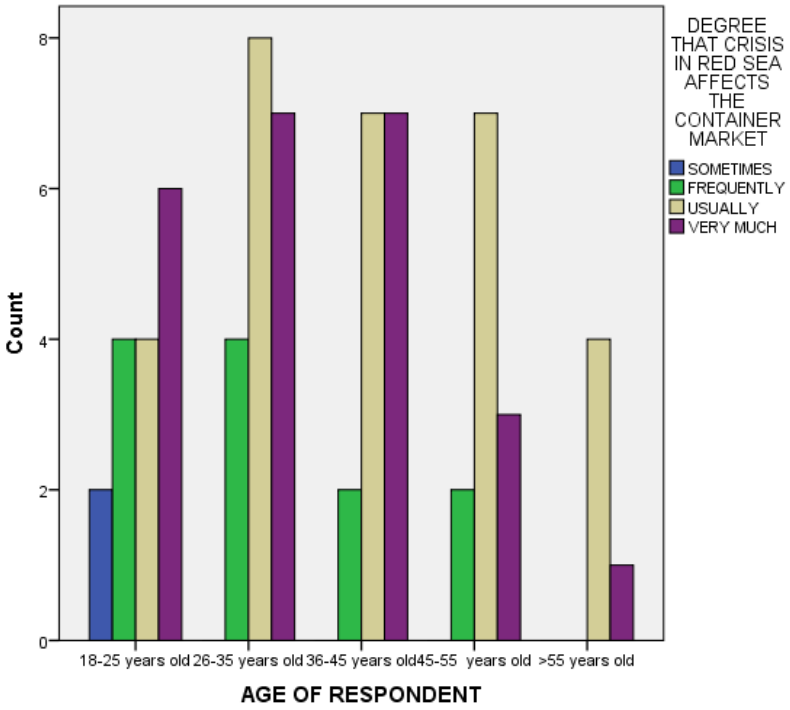

Figure 17 Degree that crisis in Red Sea affects the container market by age of respondent

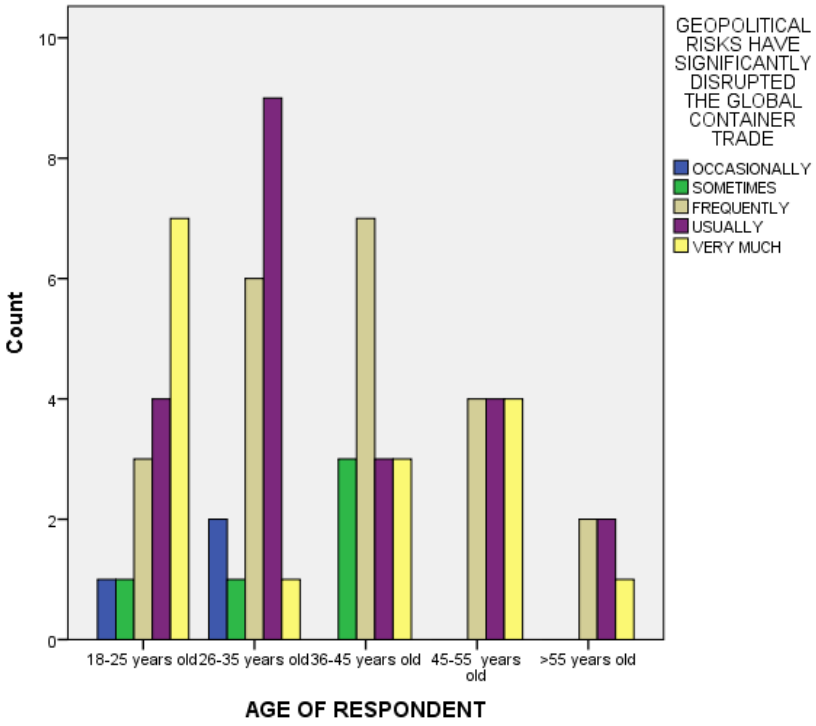

Figure 18 Extend that geopolitical risks have disrupted the global container trade by age of respondent

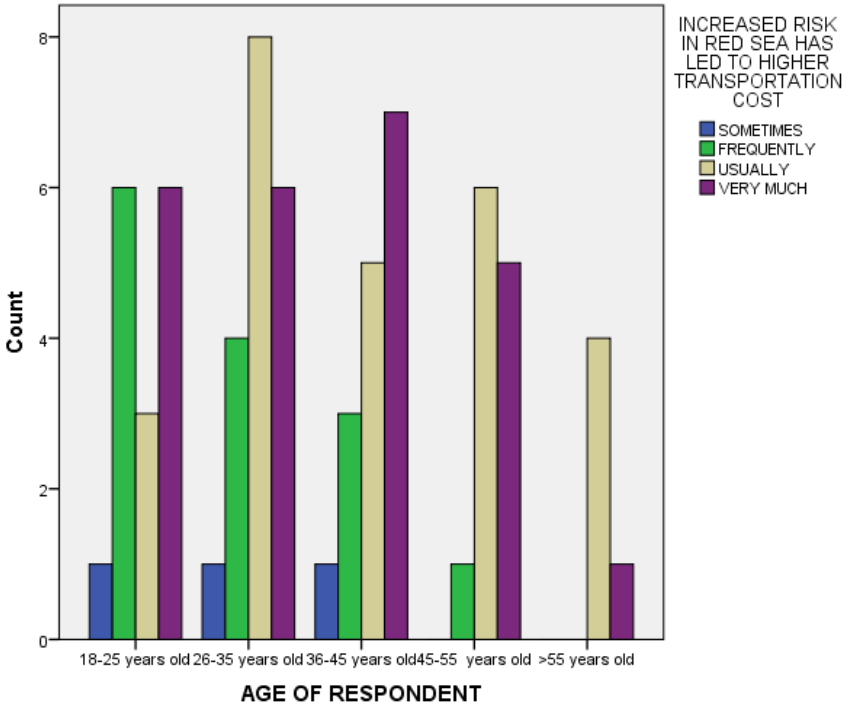

Figure 19 Extend that the increased risk in Red Sea has led to higher transportation cost by age of respondent

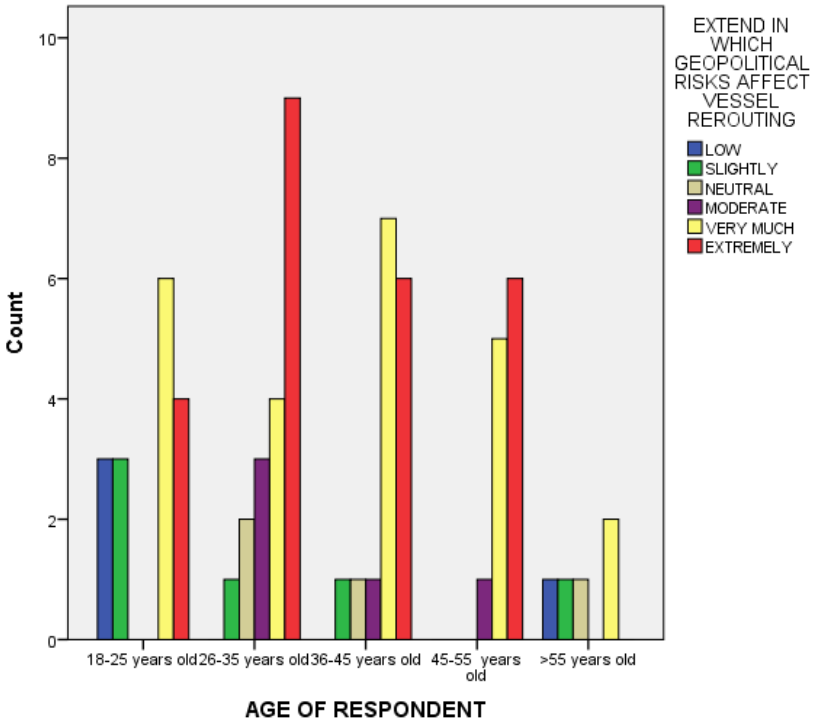

Figure 20 Extend in which geopolitical risks affect vessel rerouting by age of respondent

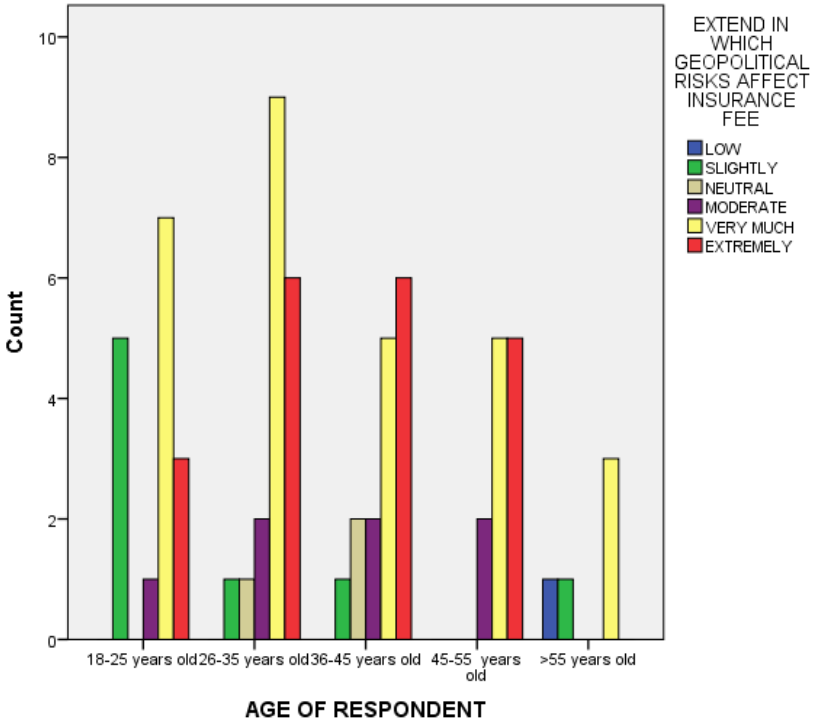

Figure 21 Extend in which geopolitical risks affect freight insurance fee by age of respondent

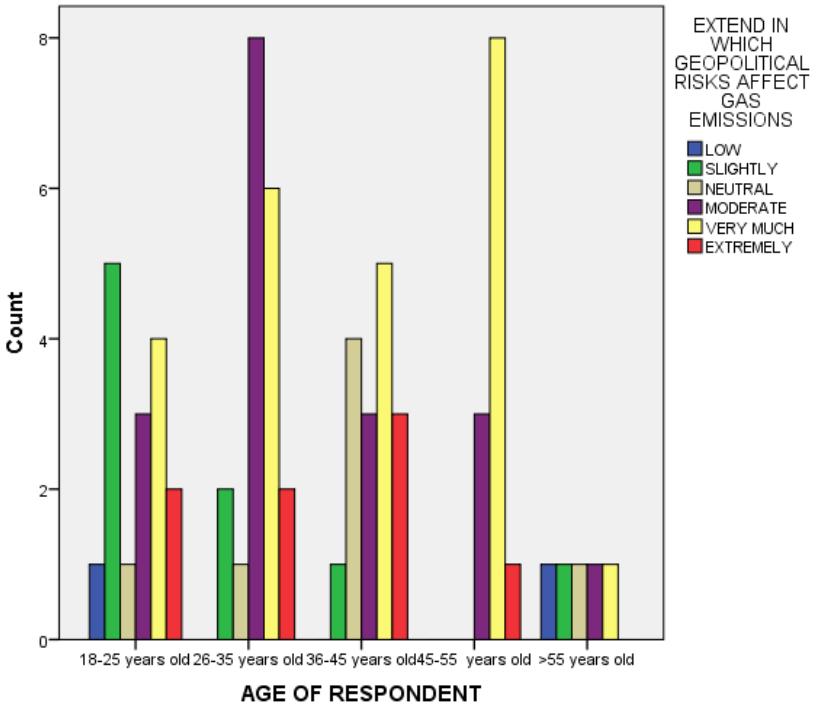

Figure 22 Extend in which geopolitical risks affect gas emissions by age of respondent

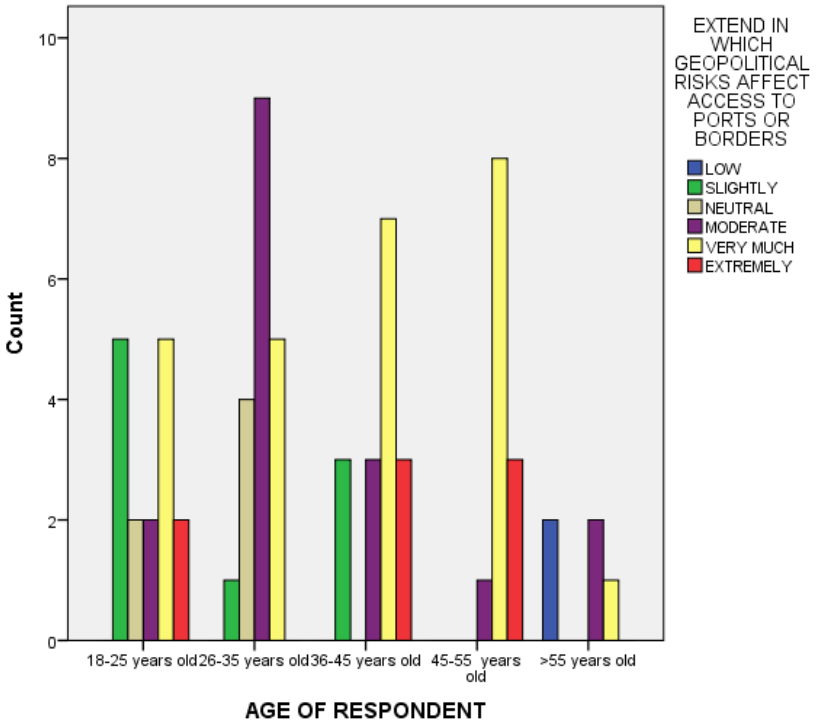

Figure 23 Extend in which geopolitical risks affect access to ports or borders by age of respondent

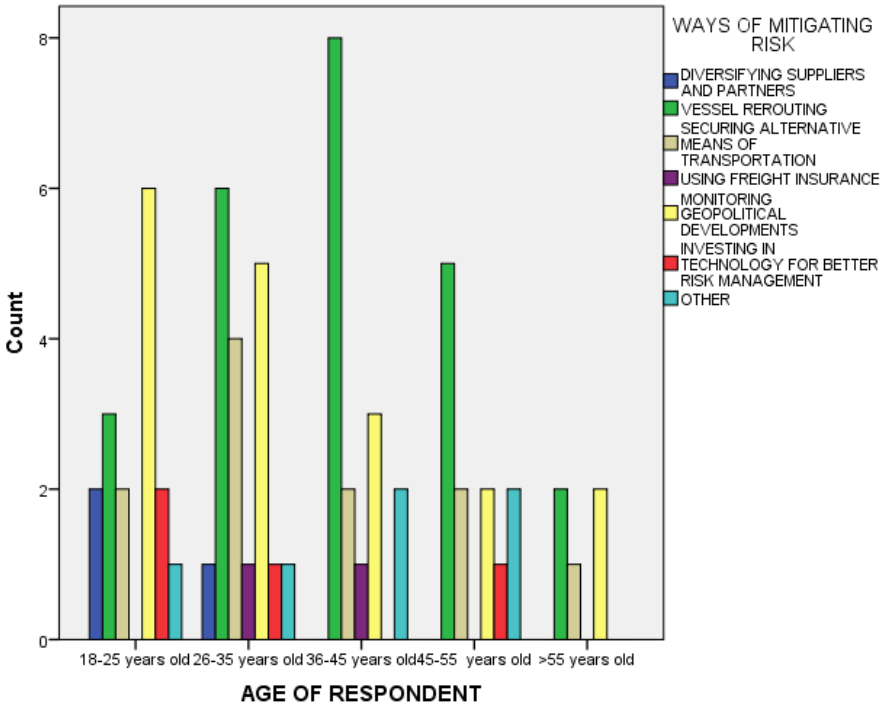

Figure 24 Ways of mitigating risk by age of respondent

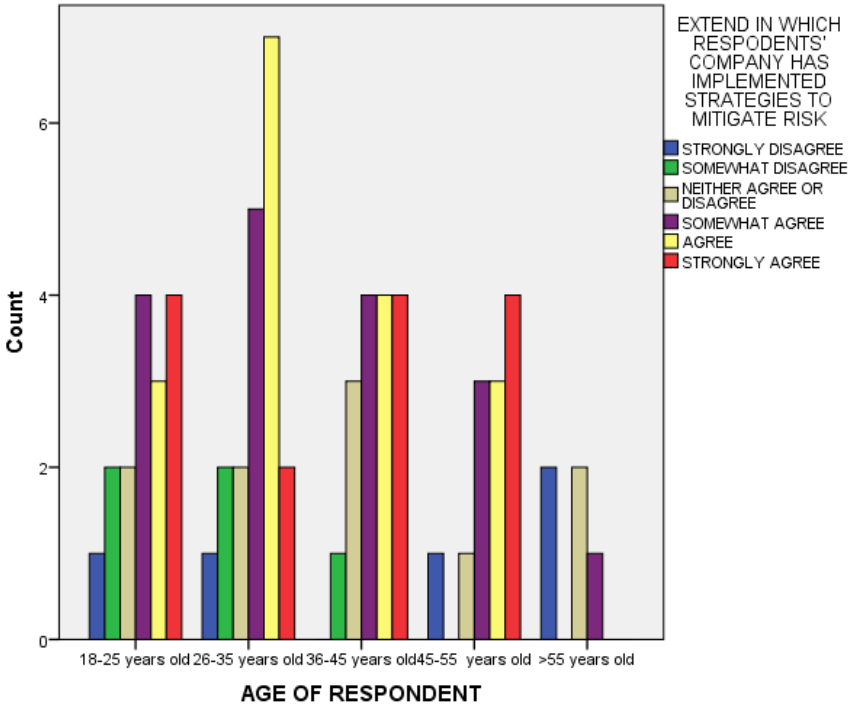

Figure 25 Extend in which respondents companies have implemented strategies to mitigate risk by age of respondent

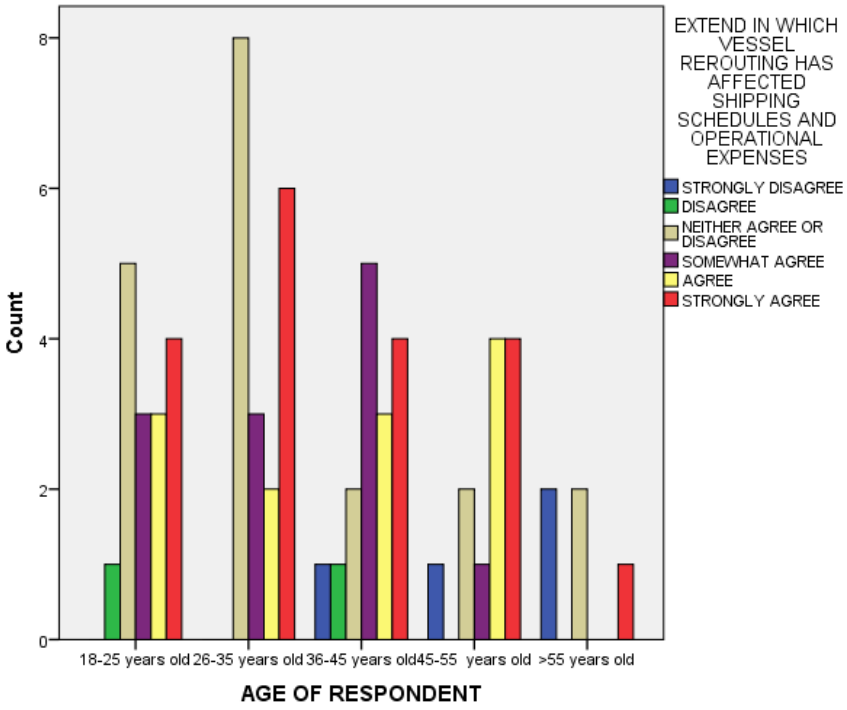

Figure 26 Extend in which vessel rerouting has affected shipping schedules and operational expenses by age of respondent

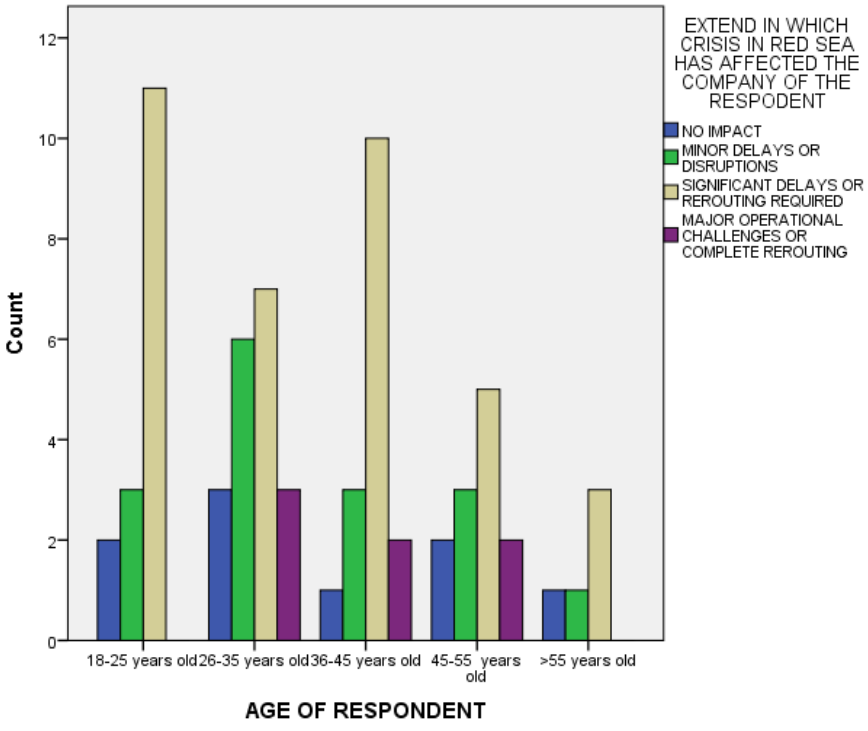

Figure 27 Extend in which crisis in Red Sea has affected the company of the respondent by age of respondent

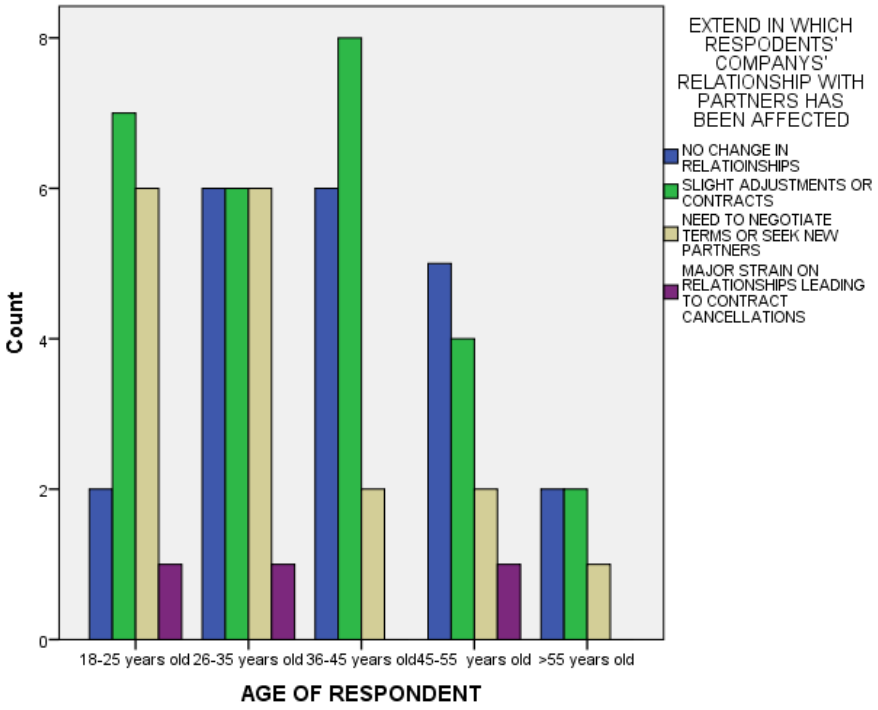

Figure 28 Extend in which respondents' company's relationship with partners has been affected by age of respondent

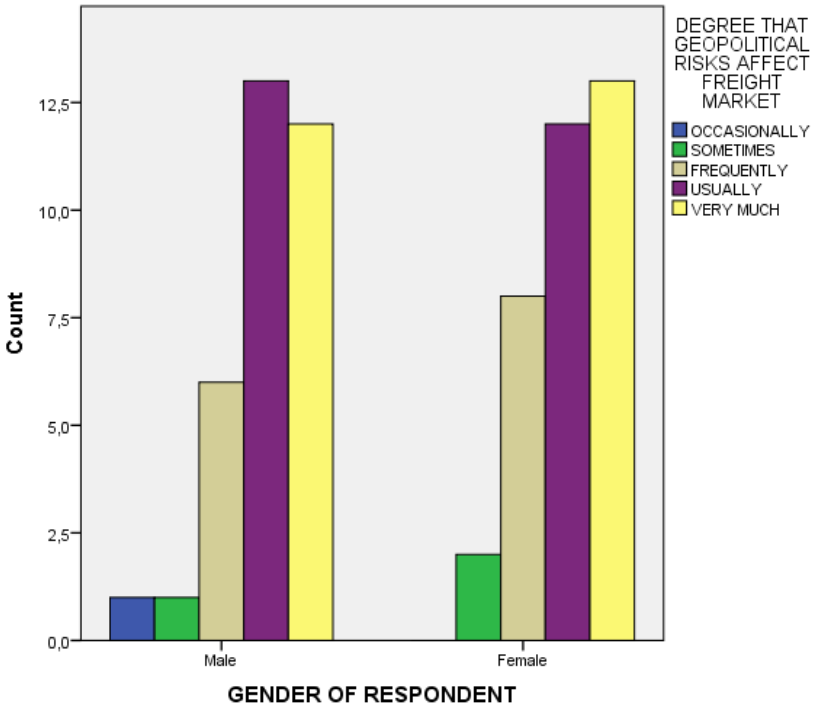

Figure 29 Degree that geopolitical risks affect freight market by gender of respondent

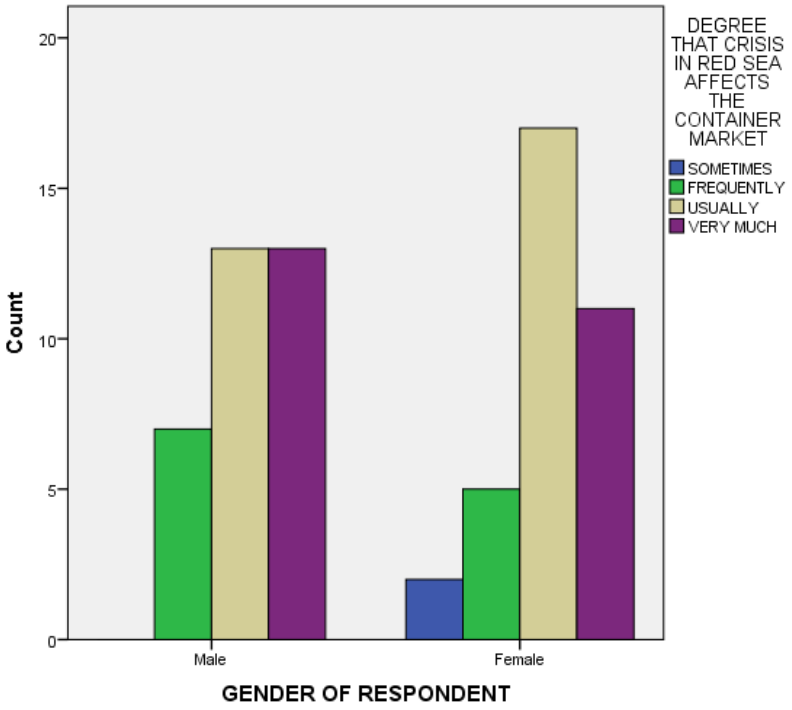

Figure 30 Degree that crisis in Red Sea affects the container market by gender of respondent

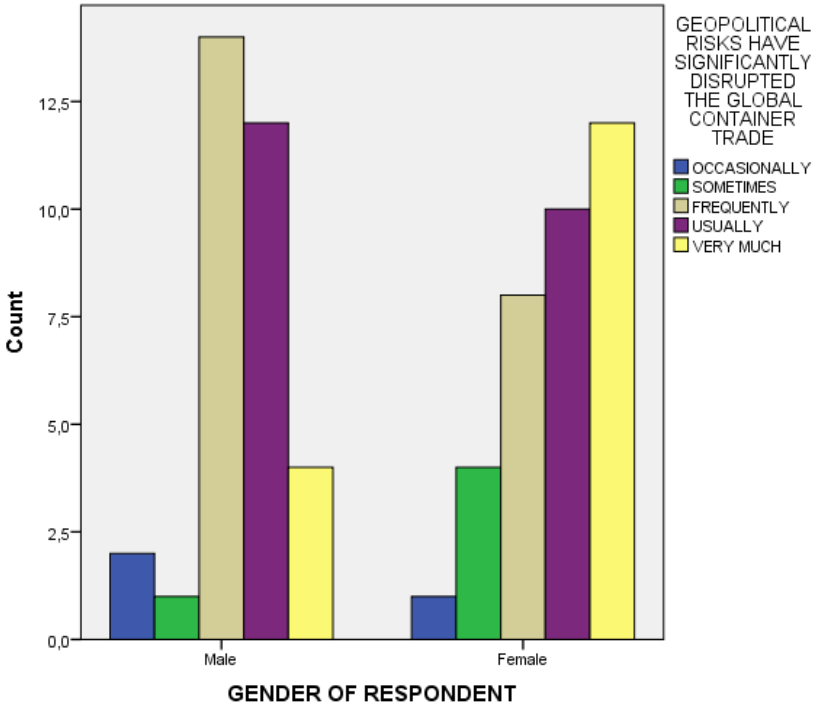

Figure 31 extend that geopolitical risks have significantly disrupted the global container trade by gender of respondent

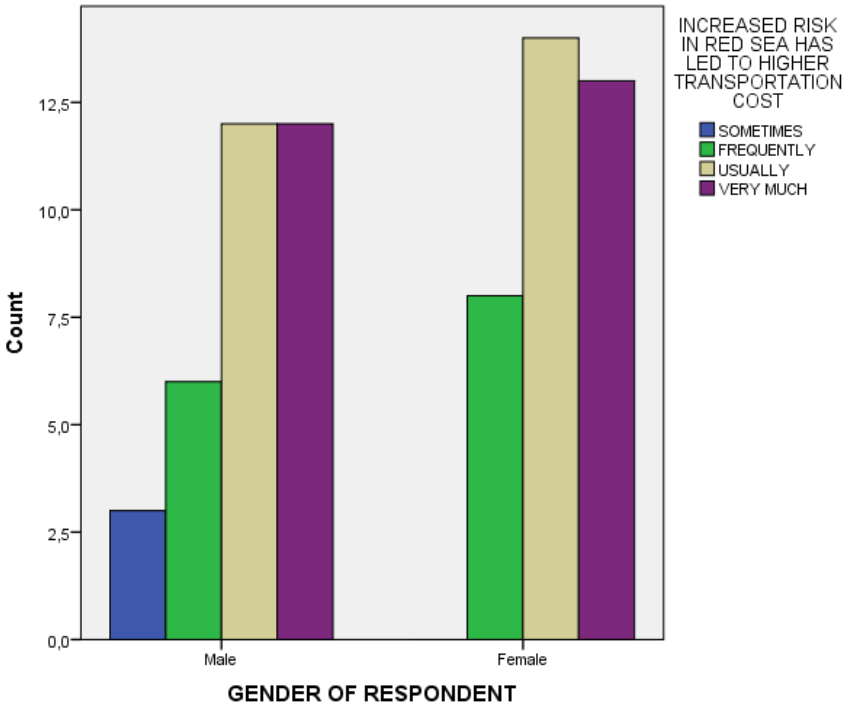

Figure 32 Extend in which increased risk in Red Sea has led to higher transportation cost by gender of respondent

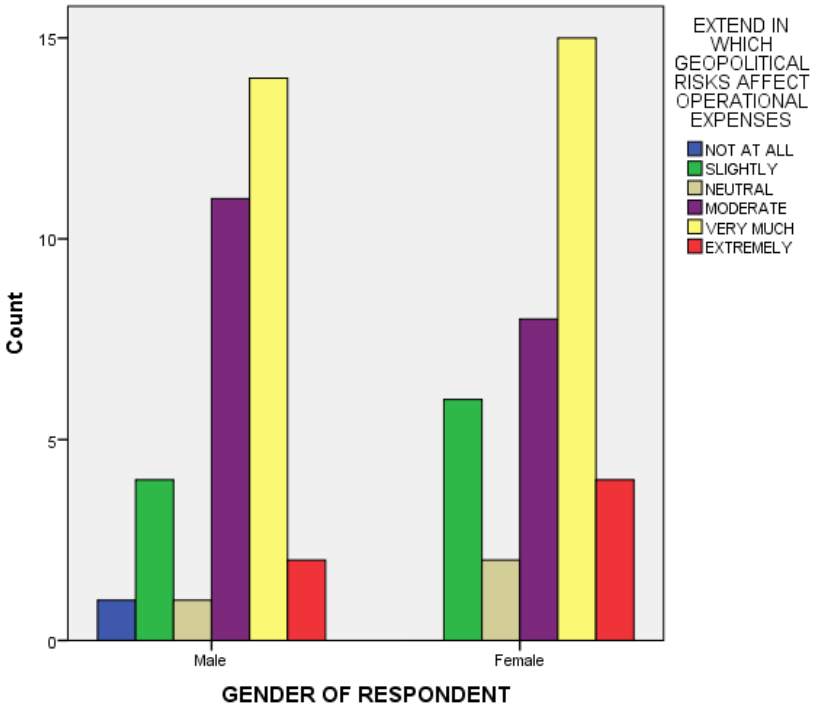

Figure 33 Extend in which geopolitical risks affect operational expenses by gender of respondent

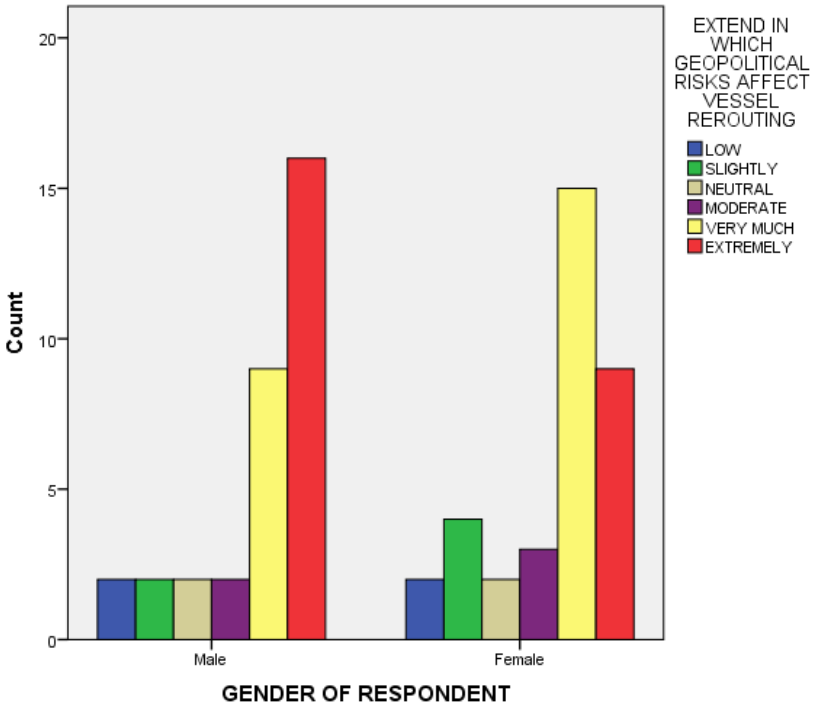

Figure 34 Extend in which geopolitical risks affect vessel rerouting by gender of respondent

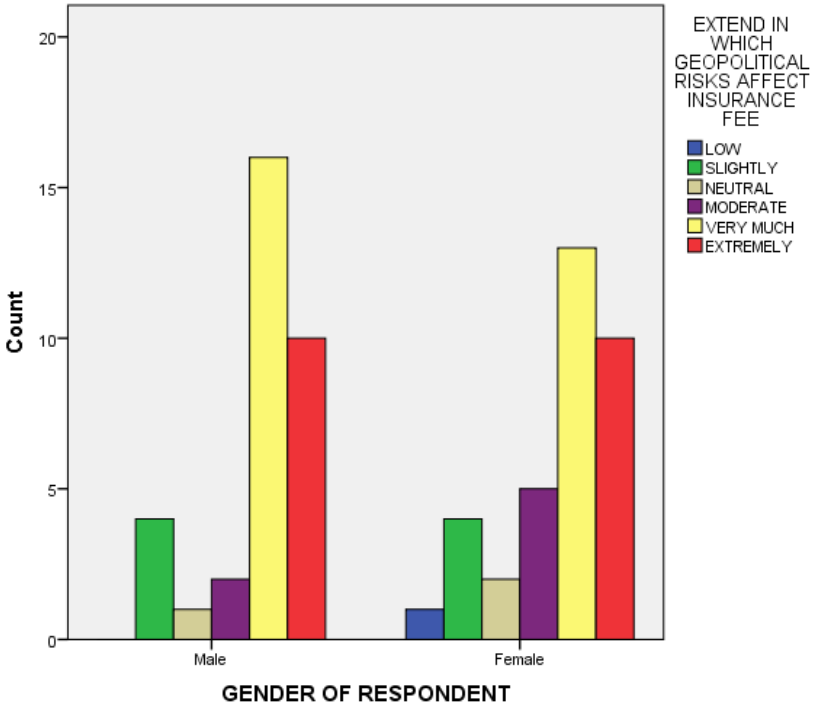

Figure 35 Extend in which geopolitical risks affect insurance fee by gender of respondent

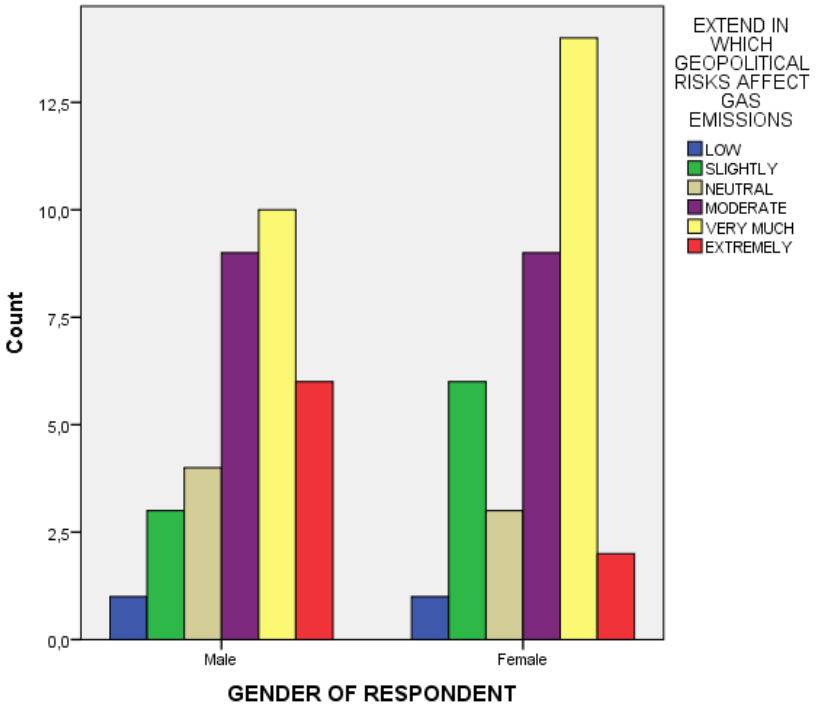

Figure 36 Extend in which geopolitical risks affect gas emissions by gender of respondent

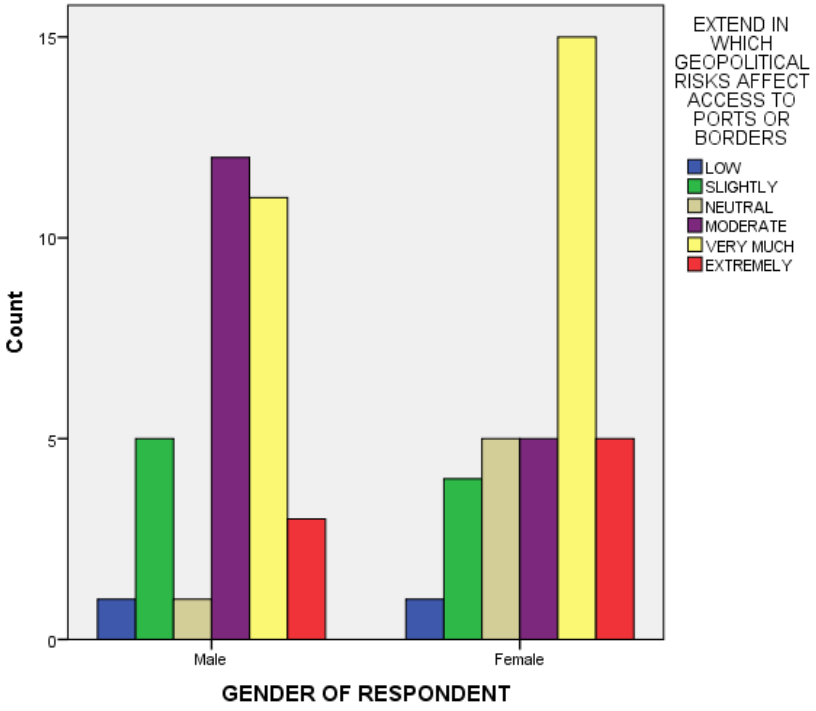

Figure 37 Extend in which geopolitical risks affect access to ports or borders by gender of respondent

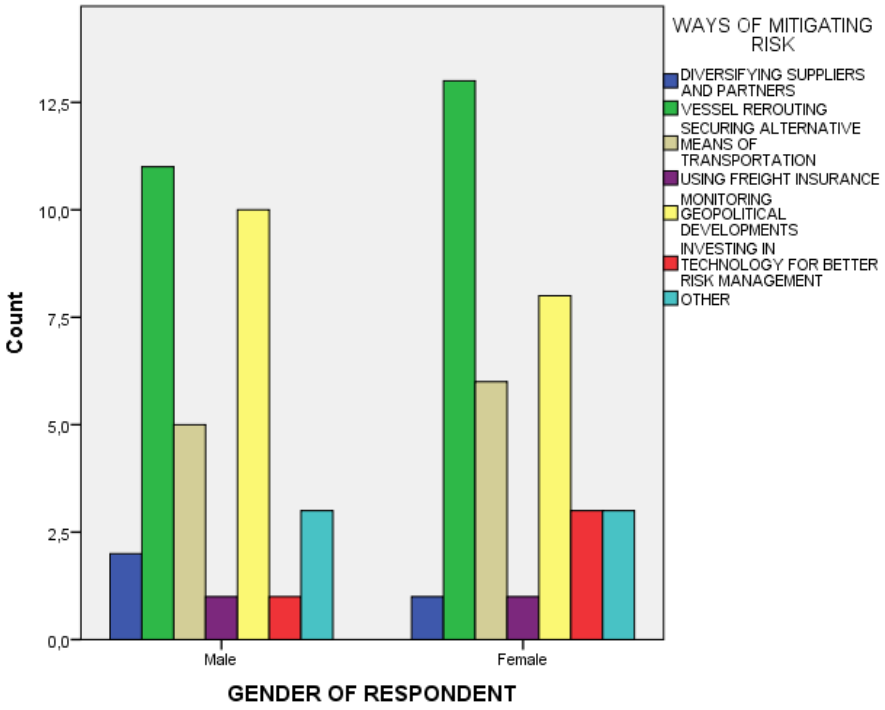

Figure 38 Ways of mitigating risk by gender of respondent

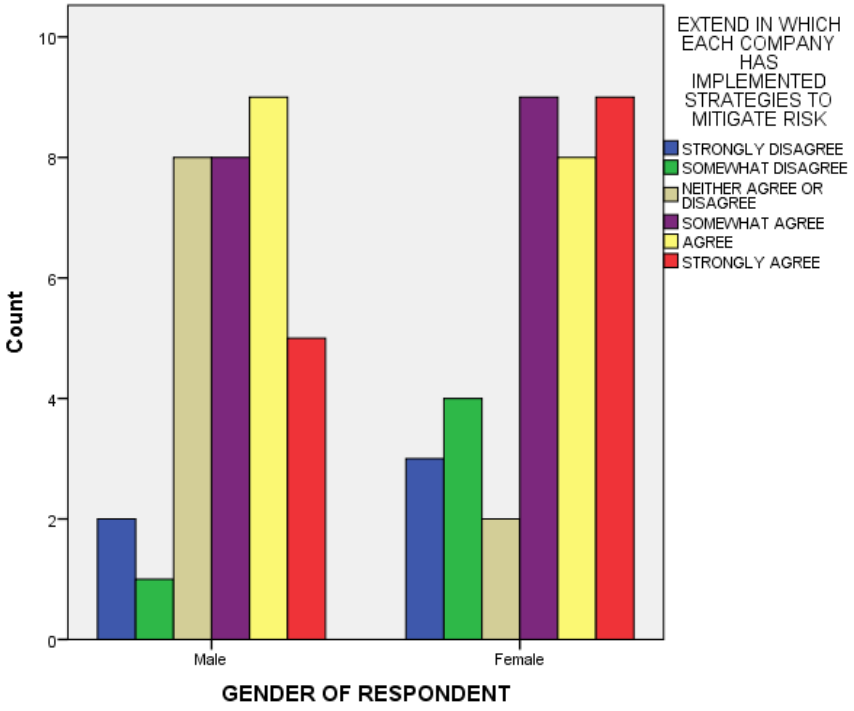

Figure 39 Extend in which company has implemented strategies to mitigate risk by gender of respondent

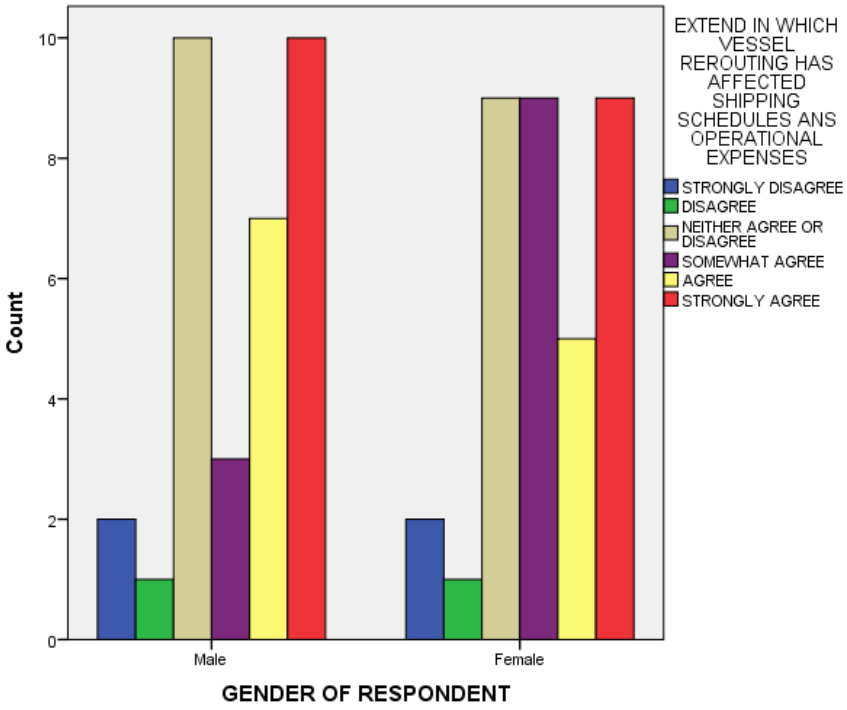

Figure 40 Extend in which vessel rerouting has affected shipping schedules and operational expenses by gender of respondent

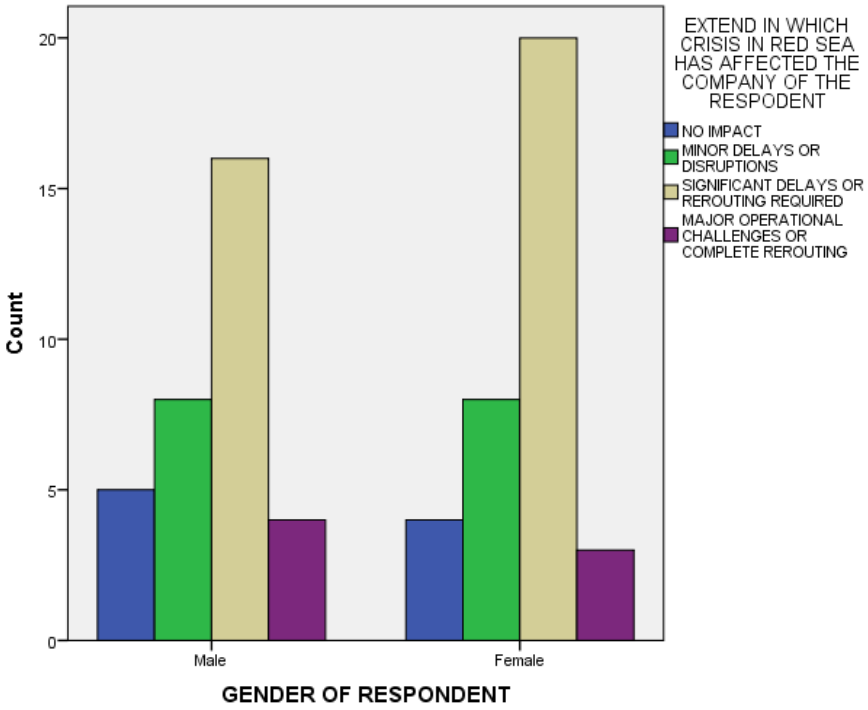

Figure 41 Extend in which crisis in Red Sea has affected the company of the respondent by gender of respondent

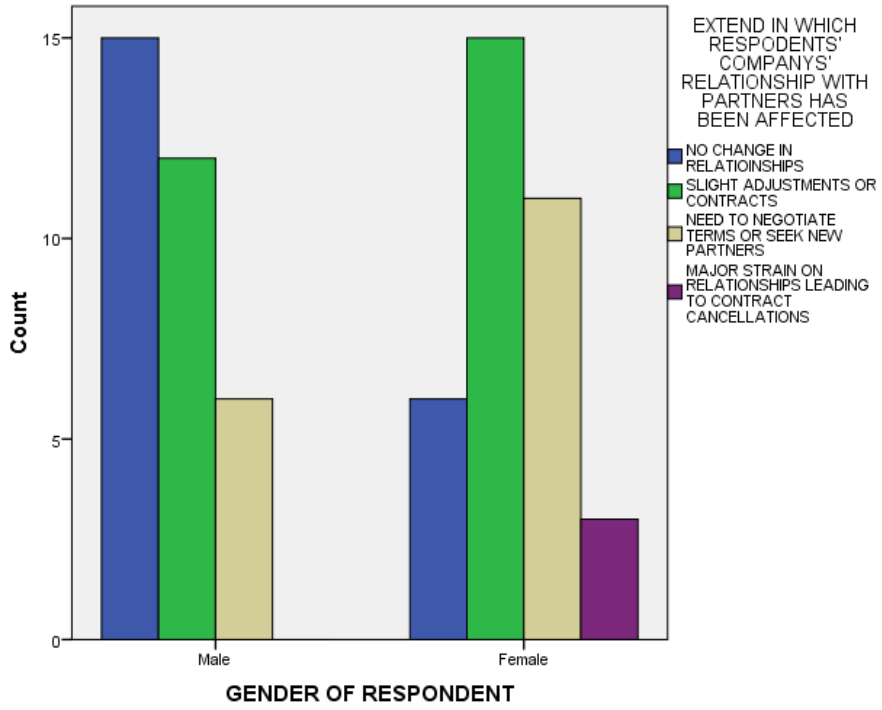

Figure 42 Extend in which respondents' company's relationship with partners has been affected by gender of respondent

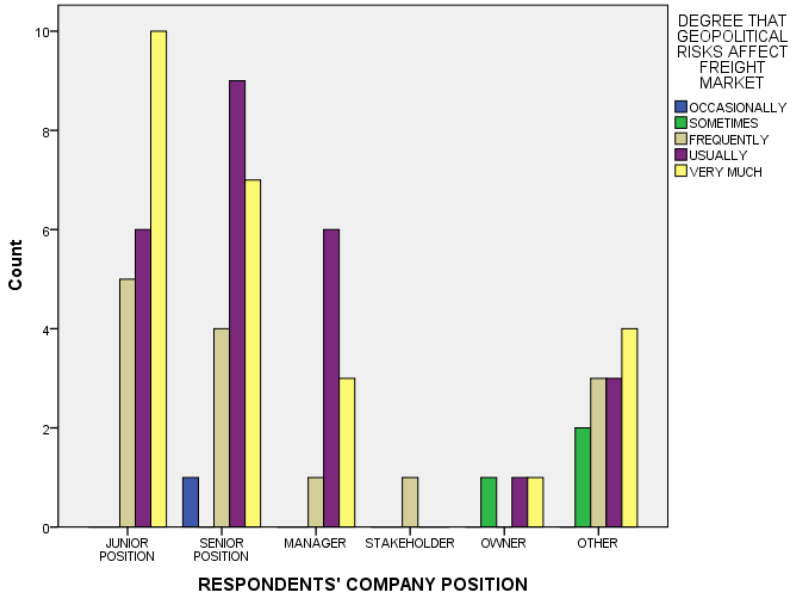

Figure 43 Degree that geopolitical risks affect freight market by respondents' company position

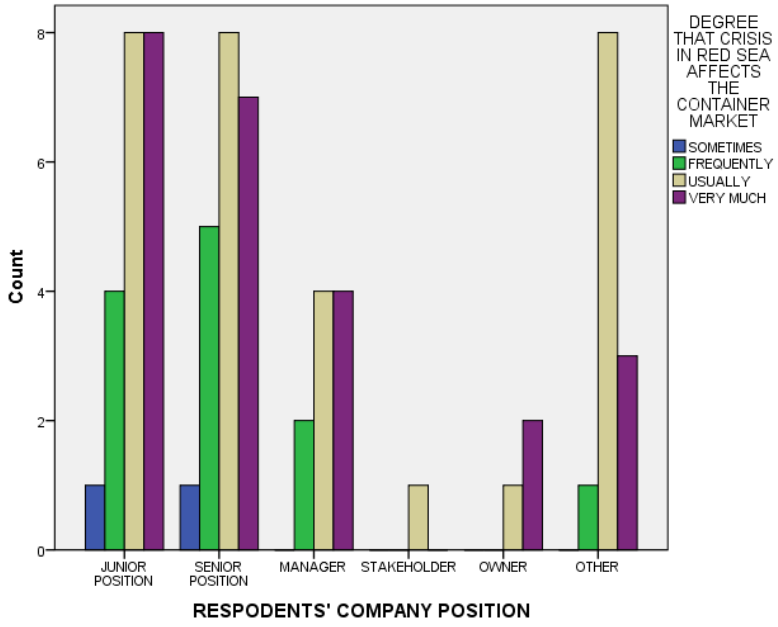

Figure 44 Degree that crisis in Red Sea affects the container market by respondents' company position

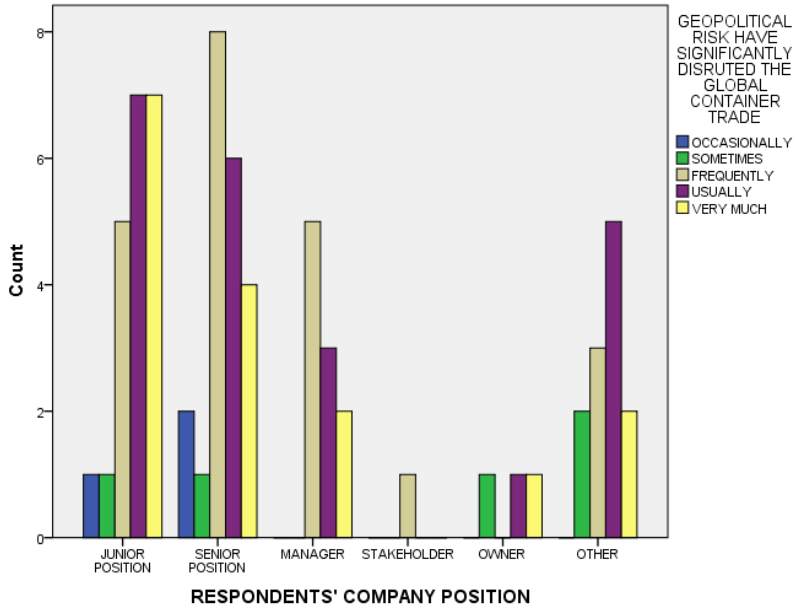

Figure 45 Extend that geopolitical risks have significantly disrupted the global container trade by respondents' company position

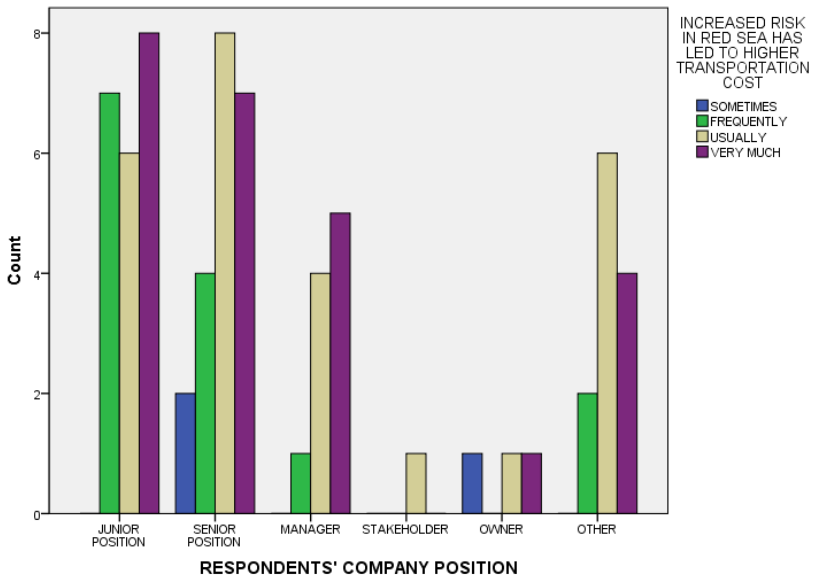

Figure 46 Extend that increased risk in Red Sea has led to higher transportation cost by respondents; company position

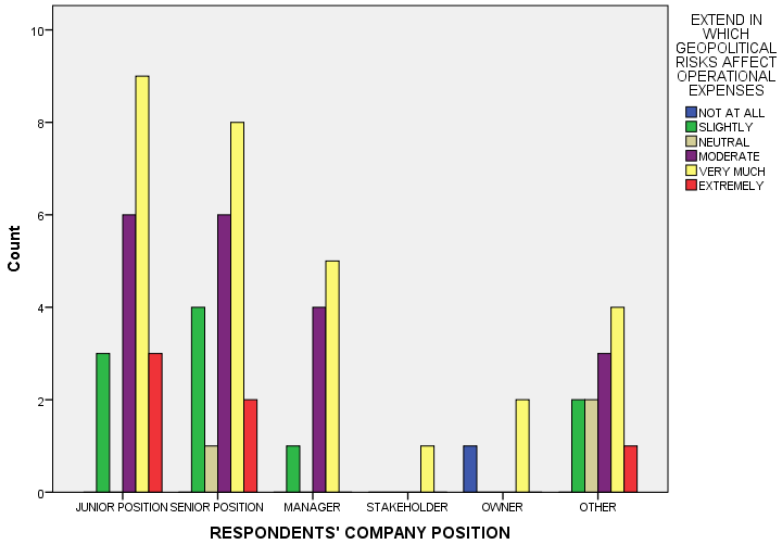

Figure 47 Extend in which geopolitical risks affect operational expenses by respondents' company position

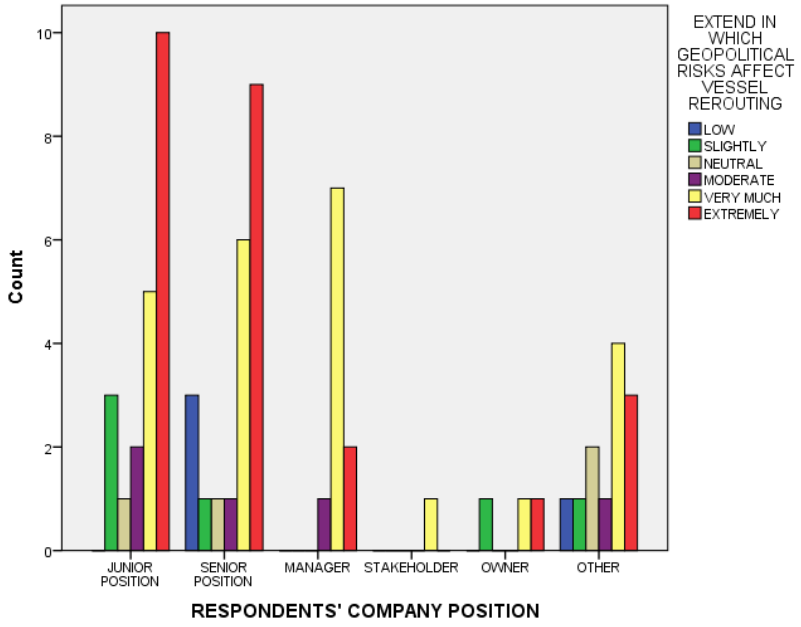

Figure 48 Extend in which geopolitical risks affect vessel rerouting by respondents' company position

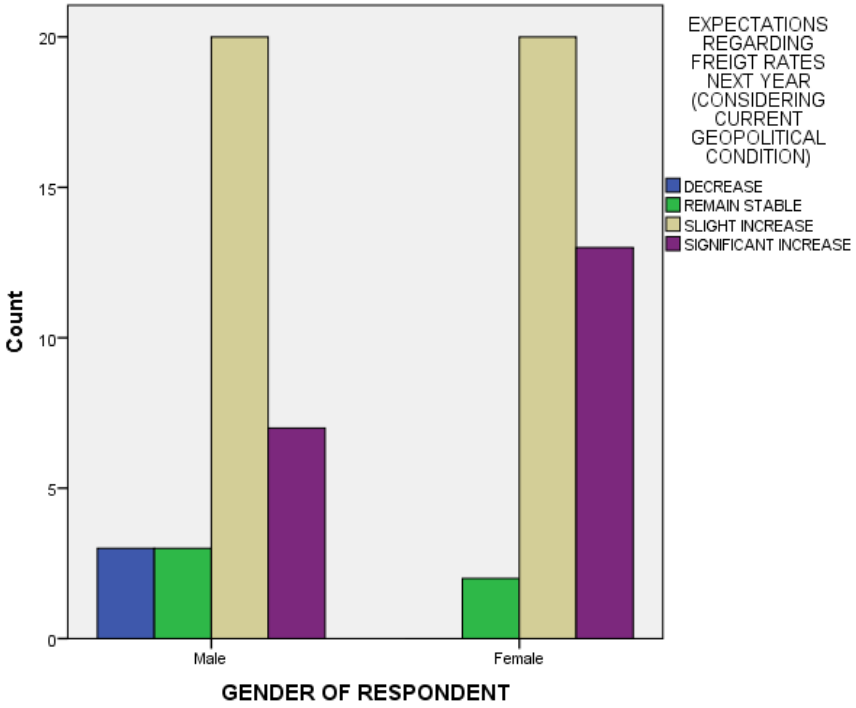

Figure 49 Expectations regarding freight rates next year by gender of respondent

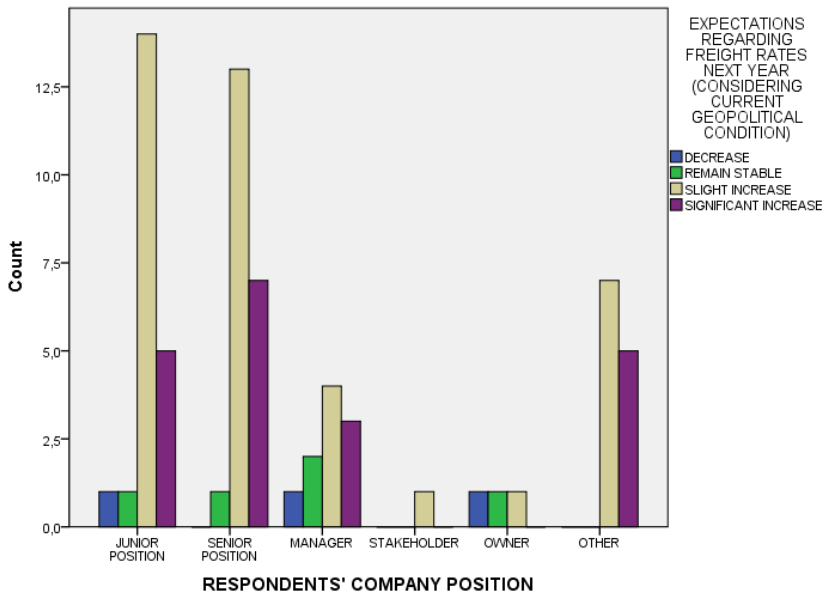

Figure 50 Expectations regarding freight rates next year by respondents' company position

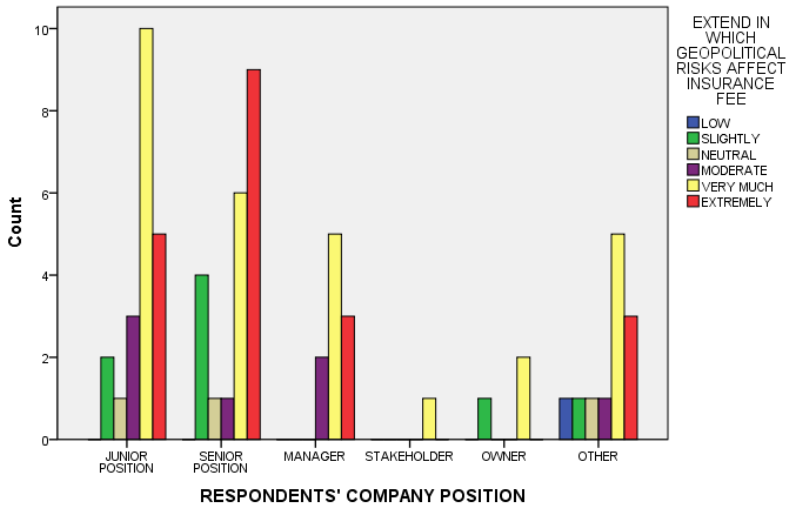

Figure 51 Extend in which geopolitical risks affect insurance fee by respondents' company position

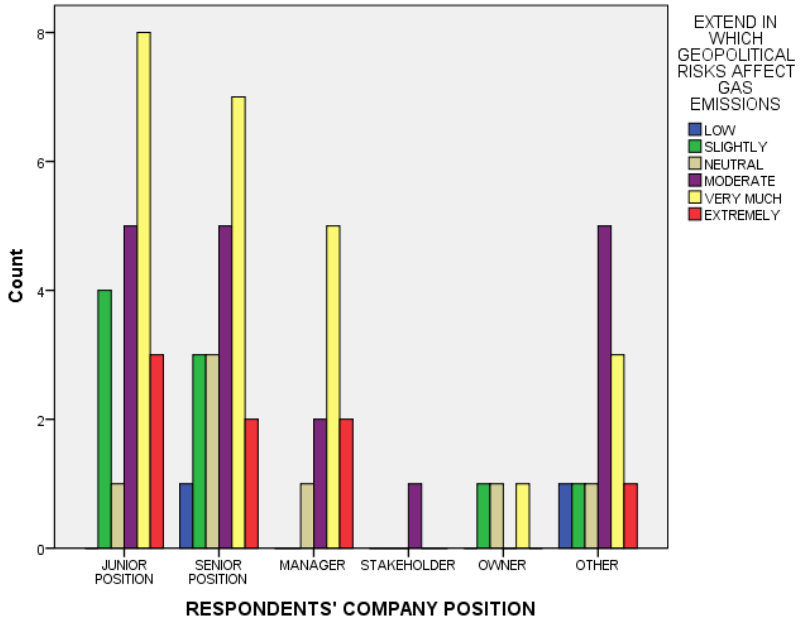

Figure 52 Extend in which geopolitical risks affect gas emissions by respondents' company position

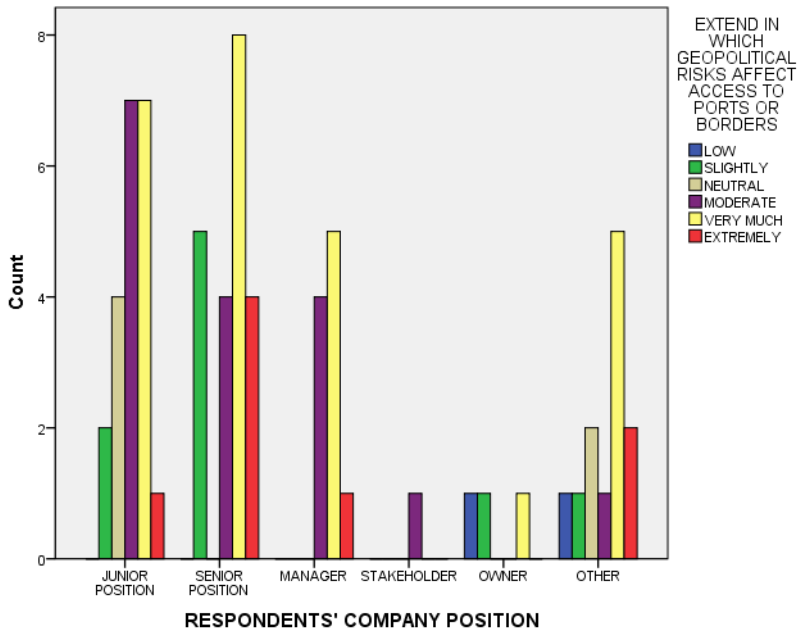

Figure 53 Extend in which geopolitical risks affect access to ports or borders by respondents' company position

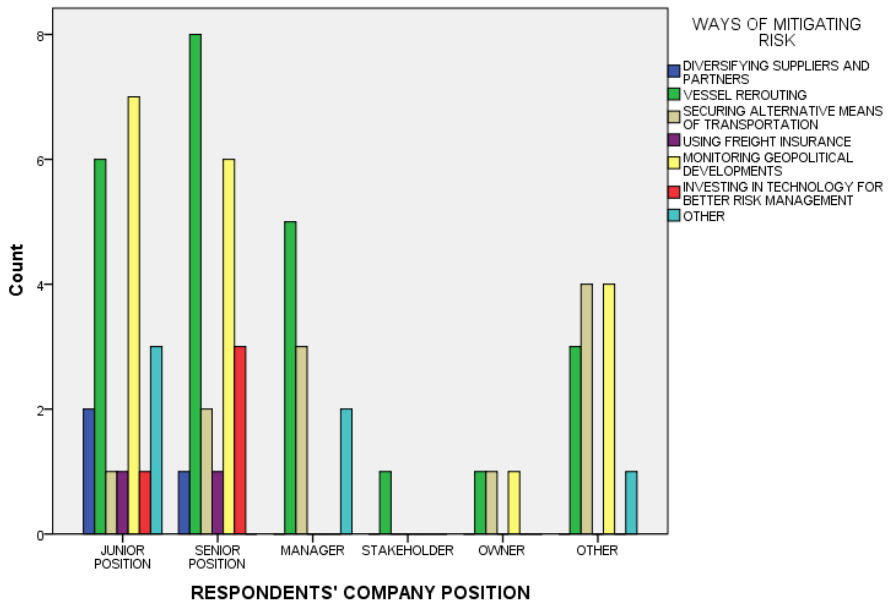

Figure 54 Ways of mitigating risk by respondents' company position

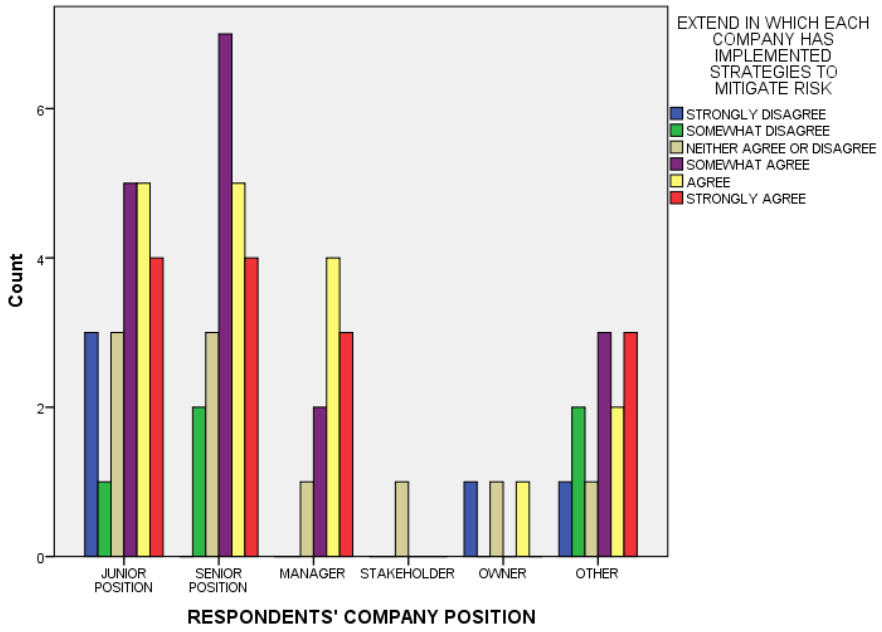

Figure 55 Extend in which each company has implemented strategies to mitigate risk by respondents' company position

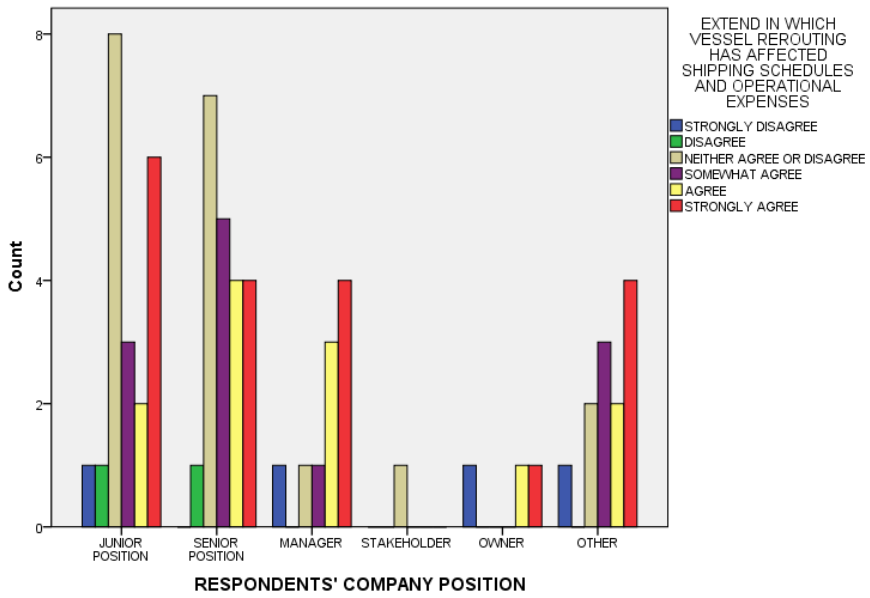

Figure 56 Extend in which vessel rerouting has affected shipping schedules and operational expenses by respondents' company position

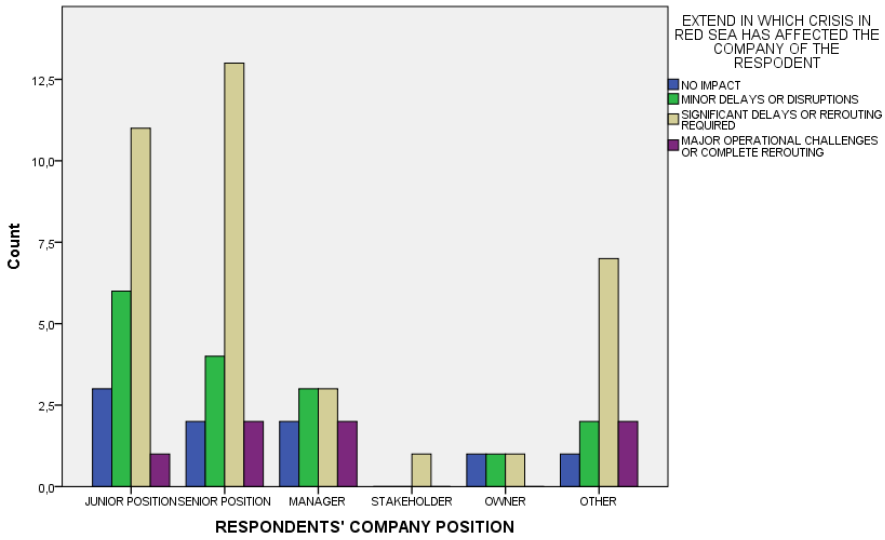

Figure 57 Extend in which crisis in Red Sea has affected the company of the respondent by respondents'' company position

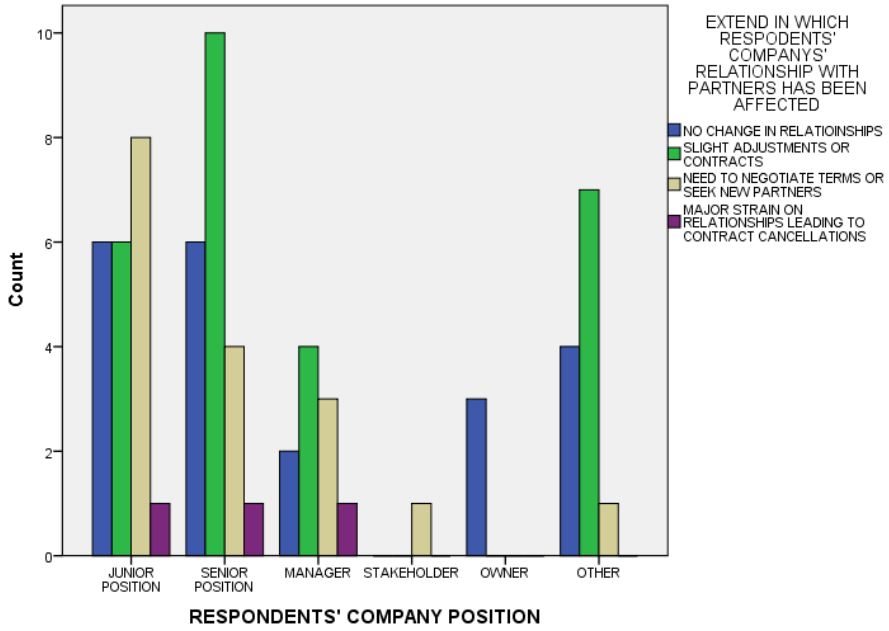

Figure 58 Extend in which respondents' company's relationship with partners has been affected by respondents' company position

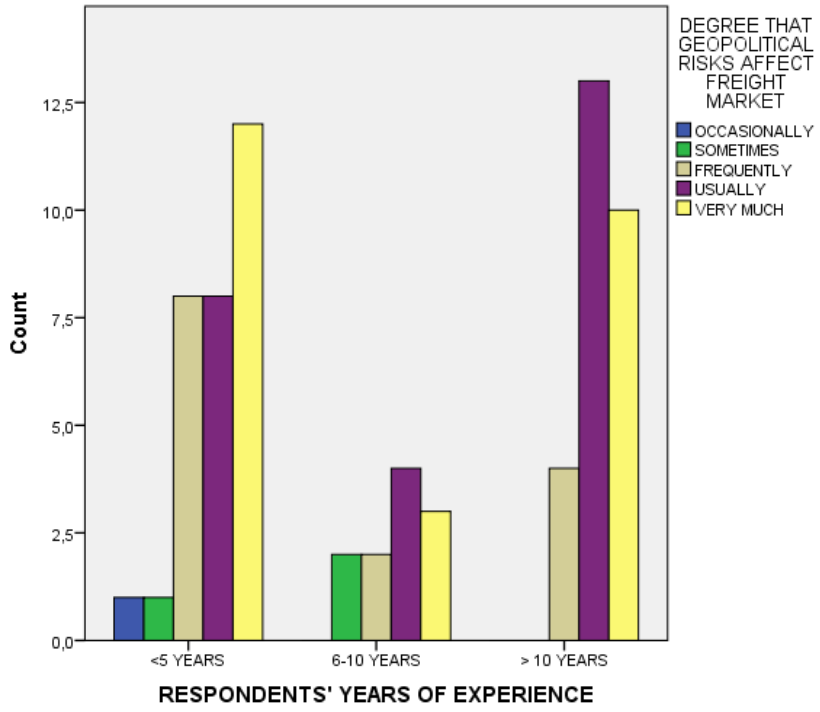

Figure 59 Degree that geopolitical risks affect freight market by respondents' years of experience

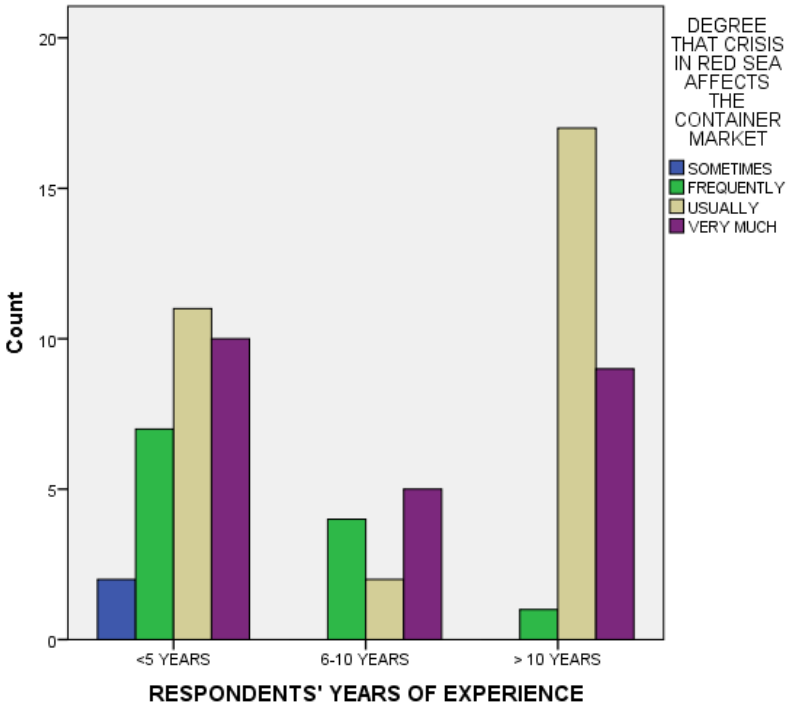

Figure 60 Degree that crisis in Red Sea affects the container market by respondents' years of experience

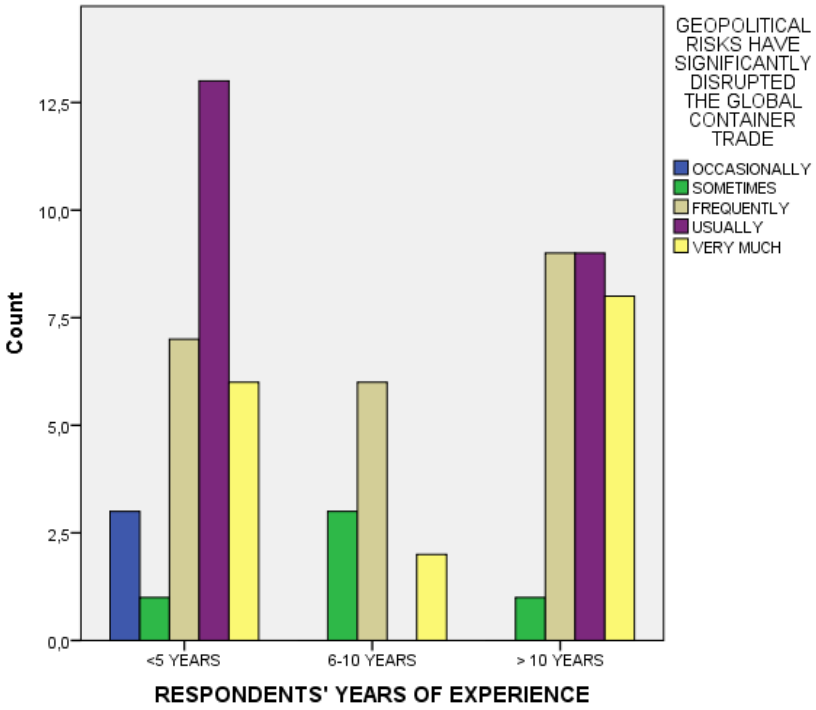

Figure 61 Extend that geopolitical risks have significantly disrupted the global container trade by respondents'' years of experience

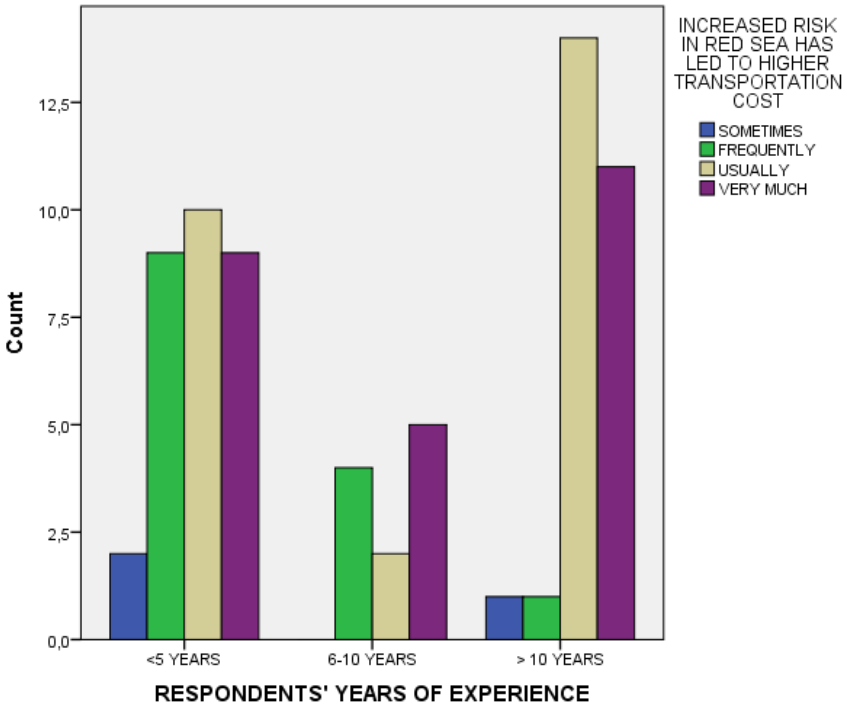

Figure 62 Extend in which increased risk in Red Sea has led to higher transportation cost by respondents' years of experience

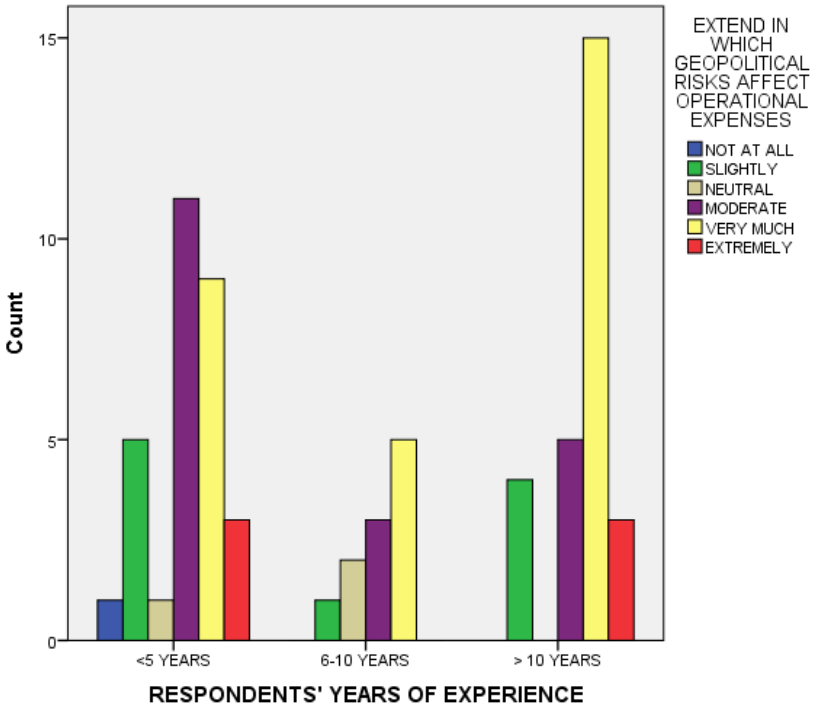

Figure 63 Extend in which geopolitical risks affect operational expenses by respondents years of experience

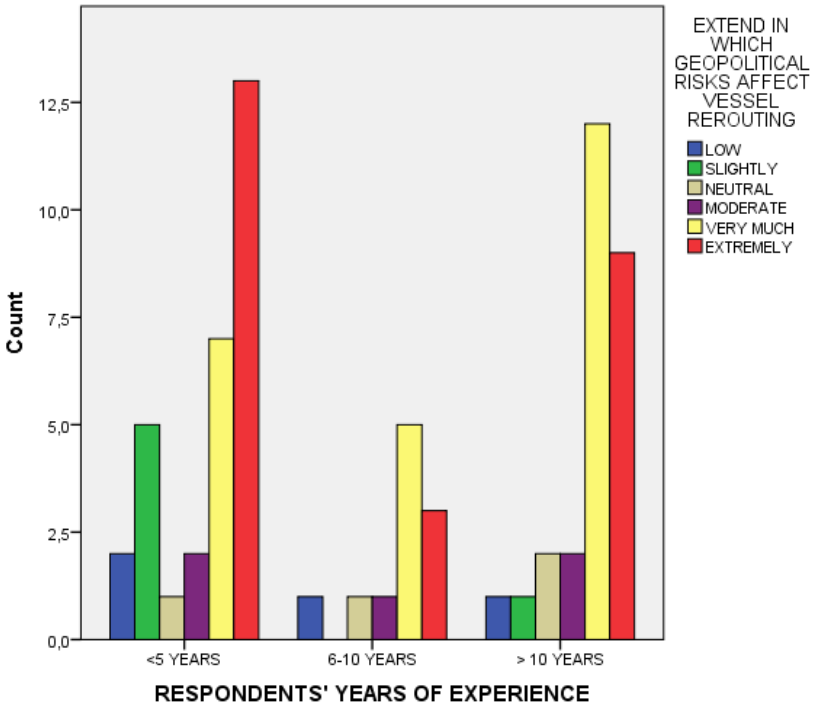

Figure 64 Extend in which geopolitical risks affect vessel rerouting by respondents' years of experience

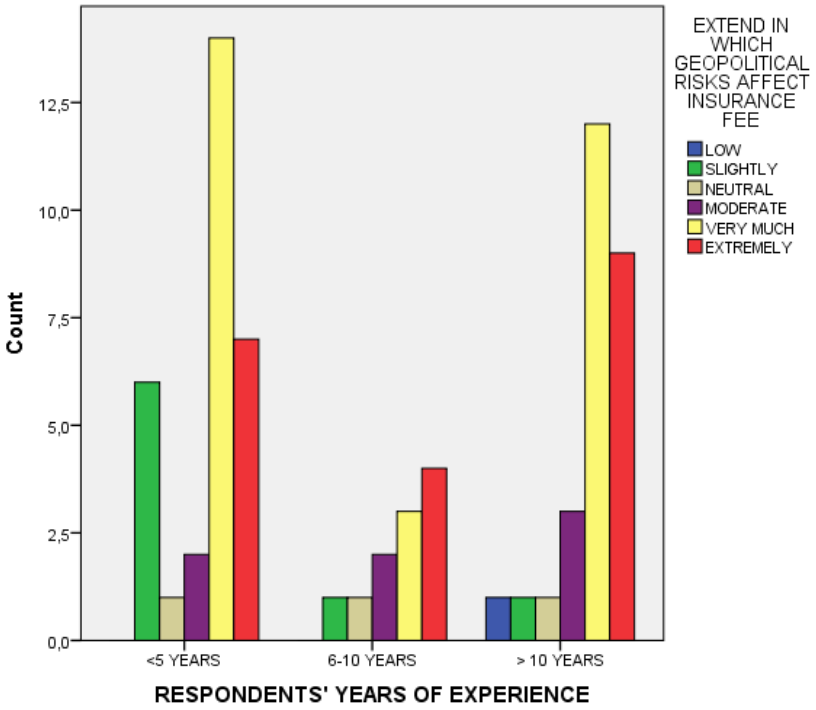

Figure 65 Extend in which geopolitical risks affect insurance fee by respondents' years of experience

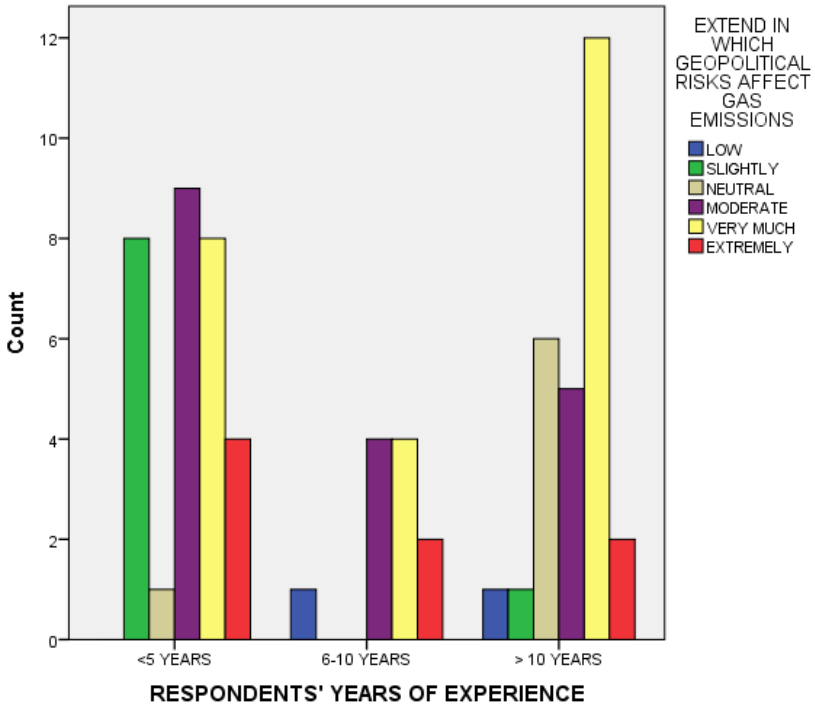

Figure 66 Extend in which geopolitical risks affect gas emissions by respondents' years of experience

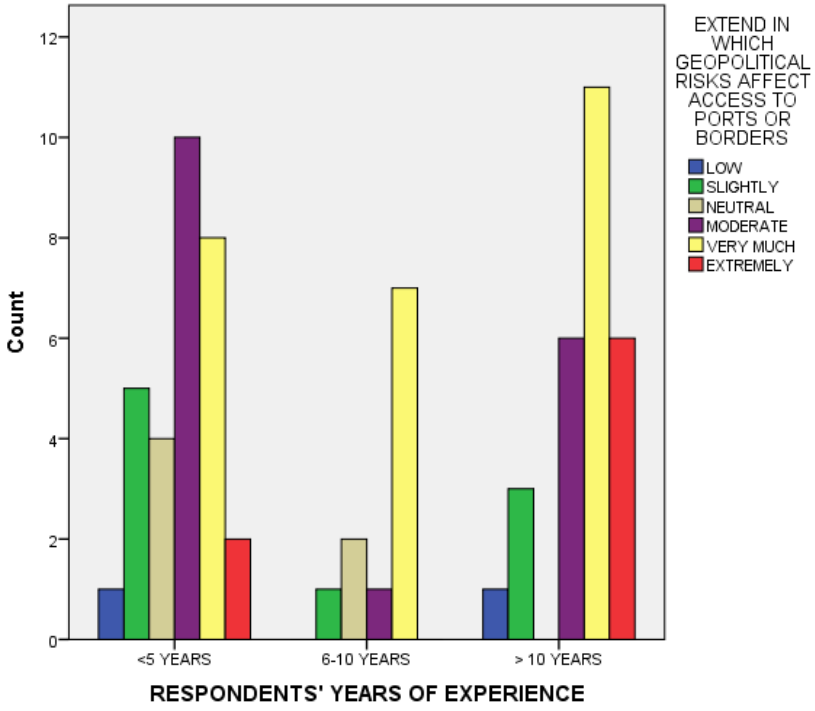

Figure 67 Extend in which geopolitical risks affect access to ports or borders by respondents' years of experience

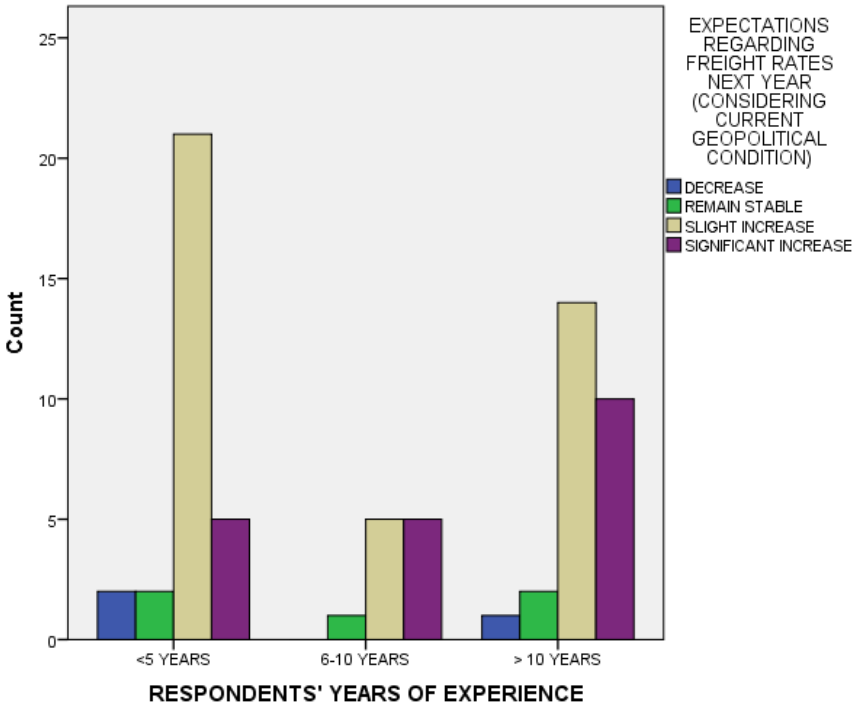

Figure 68 Expectations regarding freight rates next year by respondents' years of experience

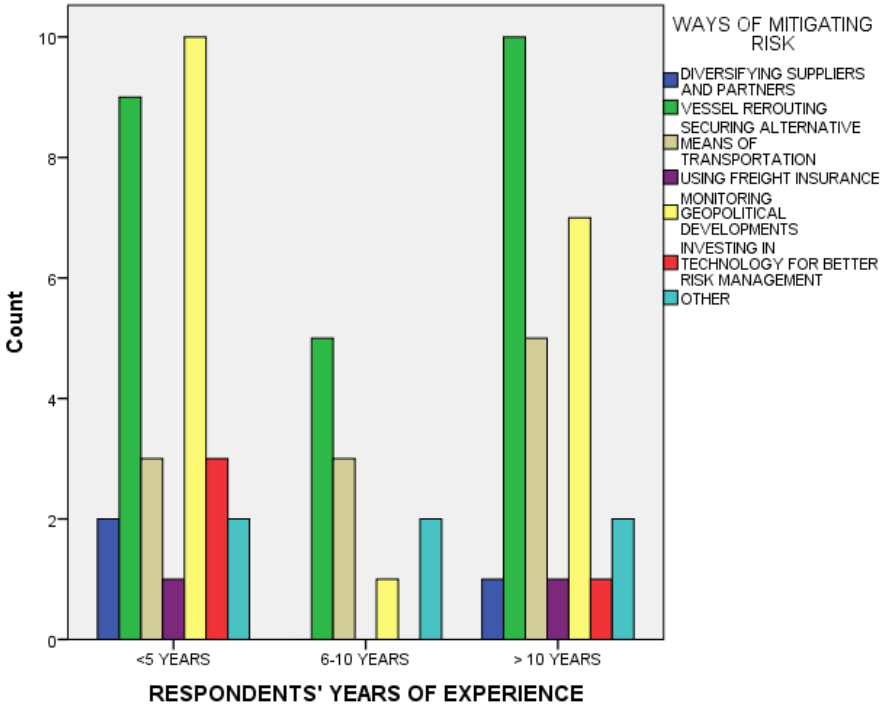

Figure 69 Ways of mitigating risk by respondents' years of experience

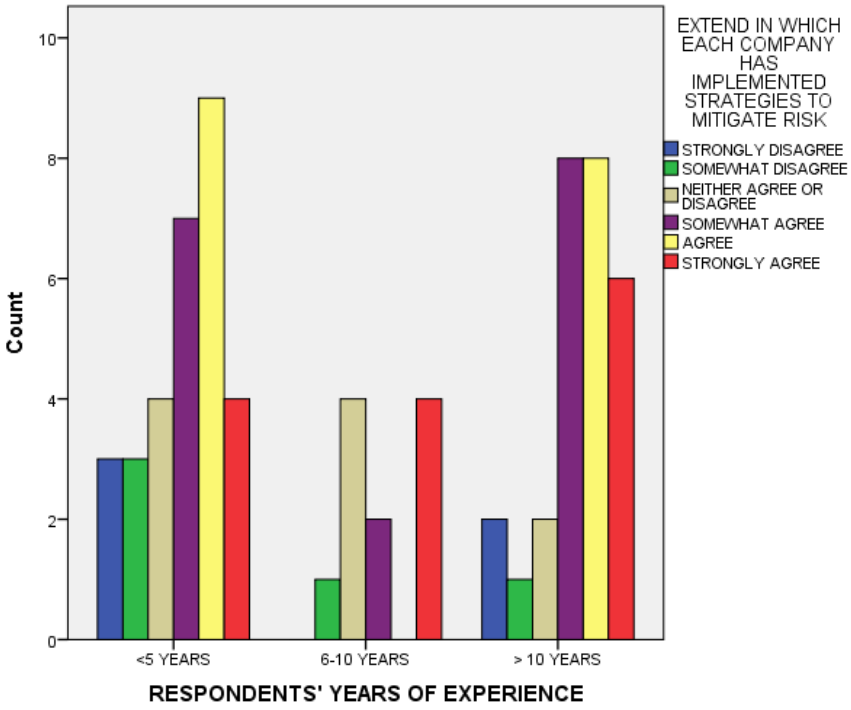

Figure 70 Extend in which each company has implemented strategies to mitigate risk by respondents' years of experience

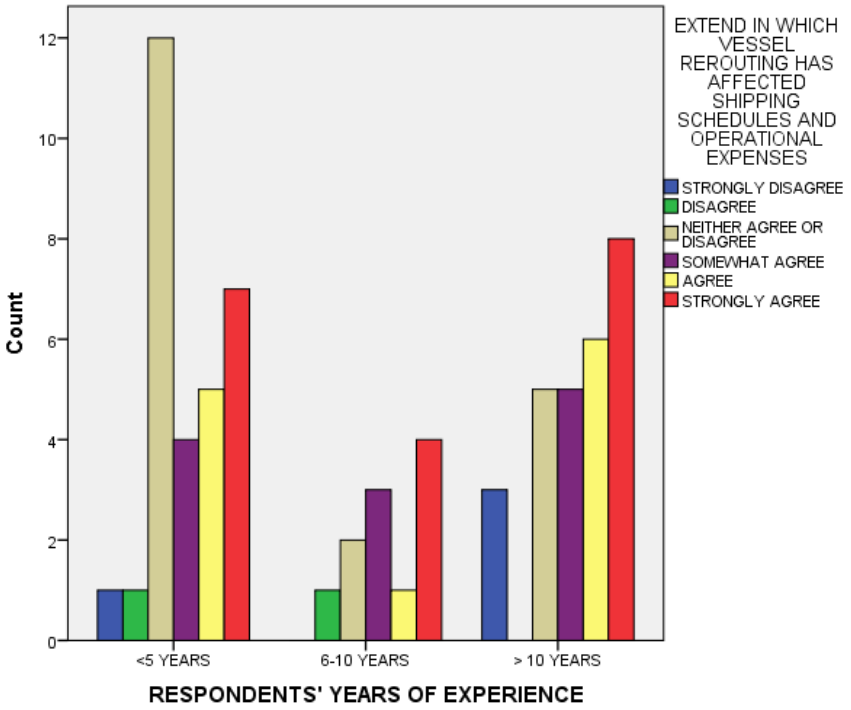

Figure 71 Extend in which vessel rerouting has affected shipping schedules and operational expenses by respondents'' years of experience

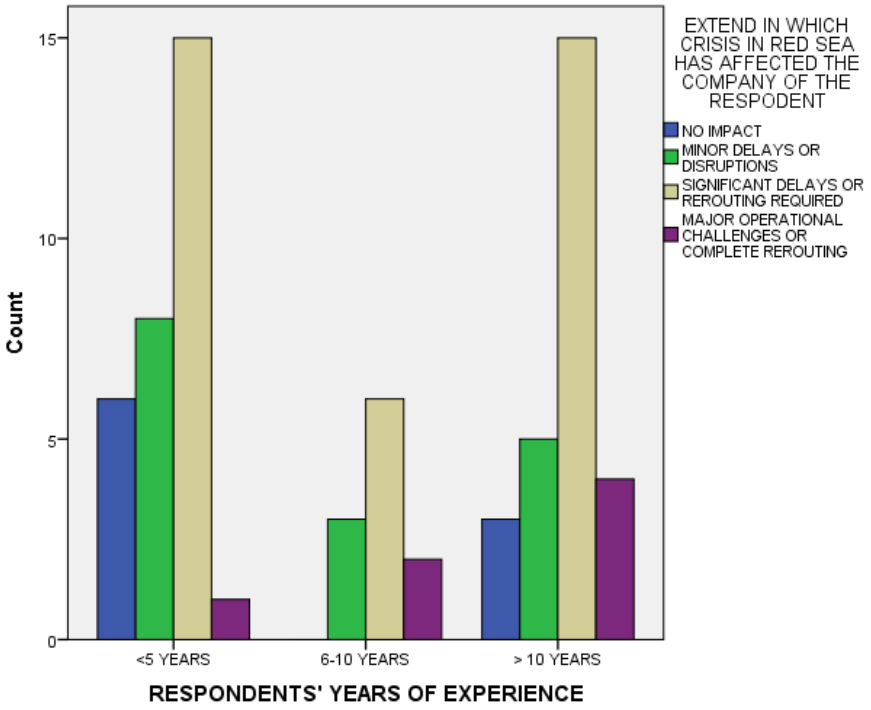

Figure 72 Extend in which crisis in Red Sea has affected the company of the respondent by respondents' years of experience

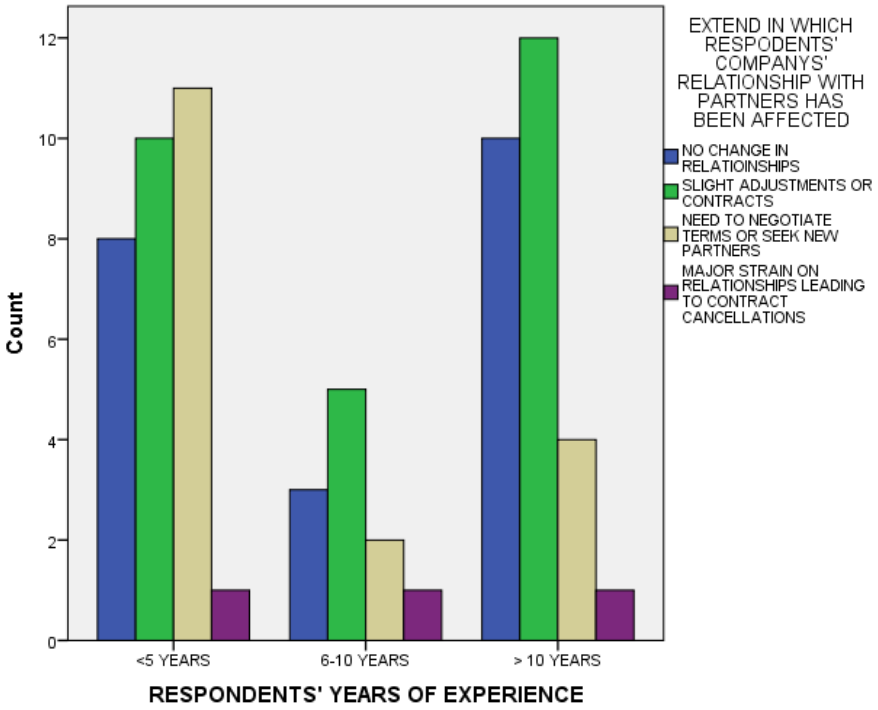

Figure 73 Extend in which respondents' company's relationship with partners has been affected by respondents' years of experience