



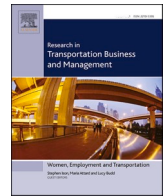
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## Cruise shipping supply chains and the impacts of disruptions: The case of the Caribbean

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### ABSTRACT

Cruise shipping supply chains have unique characteristics where product and service providers accommodate stringent requirements related to the nature of the cruise product. Since cruise ships are floating resorts that must be resupplied during their short port rotations, they require customized procurement practices. The sustainability of such practices is investigated through the lenses of contract dynamics among actors, including sourcing patterns, consumption patterns, pricing, and delivery patterns. The disruptions caused by hurricanes in the Caribbean underline the challenge the industry is facing at reconciling the risks of climate change with sustainable cruise supply chains.

### 1. Introduction

The cruise industry has experienced ongoing growth as a niche tourism market in part because of the unique sea and shore experiences it offers. From 2010 to 2018, the number of people taking a cruise jumped from 18.4 to 26.0 million. With a variety of packages, passengers are exposed to onboard entertainment, family-oriented programs, culinary experiences, live shows, and sightseeing tours along proposed itineraries. The growth of the cruise business creates challenges to the counterparties involved in the process of cruise ship procurement during their short rotation calls of 8 to 16 h. This field is defined as cruise supply chain management and has received a growing level of attention as cruise ship sizes increased, and cruise lines expanded the array of onboard services to capture additional revenue while maintaining short rotation times (Dowling & Weeden, 2017; Pallis, Rodrigue, & Notteboom, 2014).

A typical rotation involves crew changes, the unloading of the luggage of departing passengers, the screening and loading of the luggage of incoming passengers, the restocking of stores (such as food, beverages, linens), the disposal of wastes and refueling. These well-coordinated tasks are challenging as they create congestion in pier activity within a limited time frame. This congestion is increasing the demand for specialized cruise terminal facilities and equipment with the related commitment of financial resources for infrastructures that are used intensively for short periods, an issue compounded by the

seasonality of many cruise itineraries (Wang, Pallis, & Notteboom, 2014). Facilities are underused off port rotation, undermining their sustainability as an asset, particularly if there is a strong seasonality involved. Fast growth may also create a problem in recruiting and training needed labor to handle the related operations.

Further, local businesses such as catering, hospitality, entertainment, logistics can rely to various degrees on cruise activities. The nature and intensity of supply interactions remain inconsistent across suppliers. Cruise supply chains are integrated with major interdependent actors such as cruise ports, terminal management companies, cruise lines, and cruise ship service suppliers.

Understanding the concept of the cruise shipping supply chain not only provides cruise companies with comparative advantages in terms of profitability; more importantly, it contributes to an expanded scope of service reliability in the case of unpredictable events. Operating cruise itineraries in the Caribbean can be seen as paradoxical. On one side, the Caribbean is the world's most important cruise market, and therefore a source of substantial revenue for cruise lines. On the other, the Caribbean involves the most salient and recurring natural disaster risks of any cruise market in the form of hurricanes and tropical storms, which impacts both the itineraries and the cruise port infrastructure. Within this framework, the paper looks at the supply chain strategies of cruise lines regarding disruptions, such as natural disasters. The Caribbean, which is subject to recurrent hurricanes, will provide empirical evidence.

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## 2. Cruise supply chains

To maintain efficient cruise operations, supply chains connecting cruise lines and their suppliers is one of the most critical elements. Véronneau and Roy (2009) investigated the configuration of cruise ship supply chains, including manufacturing, the distribution centers of suppliers, and cruise lines, to the final delivery points (cruise ships). When the resupply window does not grow proportionally with the size of the cruise vessel, operational challenges to the cruise ship supply chain management incur (Véronneau & Roy, 2009; Véronneau, Roy, & Beaulieu, 2015). Demand forecasting becomes much more critical since the vessel is considered self-sufficient once it departed from its turn port. Thus, a cruise ship and its procurement are designed to be a sustainable mass tourism unit during its planned itinerary. Given limited storage space and various passenger preferences, procurement often involves longer replenishment lead-time and buffer inventory in the resupply process. Thus, it is important to understand the functionality of the procurement process to pursue efficient operations and cost-saving revenue management.

Supplying a capacity-constrained customer over a given booking period shows a high level of variability across sectors such as hotels and airlines. For instance, Song, Liu, and Chen (2013) investigated value chains in the tourism sector, Sun, Jiao, and Tian (2011) focused on cruise marketing and revenue management, and Wang, Wallace, Shen, and Choi (2015) looked at supply chains in the service sector. The combination of mobility and amenities (rooms, restaurants, entertainment) represents a unique risk and revenue management for the cruise industry, which has been emphasized (Sun, Liu, Tang, & Bao, 2016; Talluri & van Ryzin, 2004; Toh, Rivers, & Ling, 2005). However, due to unique characteristics such as stochastic demand realized after purchase orders, limited capacity for stores, price differentiation for cabin types and class fares, and perishable inventory, conventional supply chain

management does not fit well into the scope of a cruise. The literature cited above underlines challenges such as a relatively long booking window for reservations with products sold in advance, purchase restrictions in wholesale packages, and inventory and spacing issues for perishable and consumables. For example, the procurement and delivery process for perishable goods from local vendors and cruise distribution centers to cruise ship needs to be carefully monitored for quality and safety since there will be no opportunity to modify an order once a cruise ship has left its turn port.

When human errors and unforeseeable disruptions caused by natural disasters occur, the standard daily operational procedures will be affected. The literature covering the cruise procurement process employs conventional supply chain perspectives dealing with the unique attributes of cruising, namely the intensity of interactions during a cruise ship turn and single-sourcing for a whole cruise (Erkoc, Iakovou, & Spaulding, 2005; Véronneau et al., 2015; Zhang, Song, & Huang, 2009). There are, however, aspects of cruise supply chains that differ significantly from the convention.

The cruise industry has its actors and interactions, which are represented in Fig. 1. Like conventional supply chains, the physical flows of goods and services are most of the time from providers (upstream) to customers (downstream). In contrast, information flows are dominantly in the reverse direction since they relate to purchasing orders. Consumables ordered based on past consumption patterns require on-time delivery. Doing so in a seamless manner, local ship chandlers and suppliers will integrate with logistics providers and regional/global distribution centers. While cruise lines pursuing a profit-maximization focus on occupation rate per vessel, cruise ports focus on sustainable long-term contracts to utilize their facilities in terms of the total number of annual passengers served. Thus, the incentive mechanism between cruise lines and cruise ports needs to align along with different objectives. Meanwhile, due to the short resupply window, it is crucial for

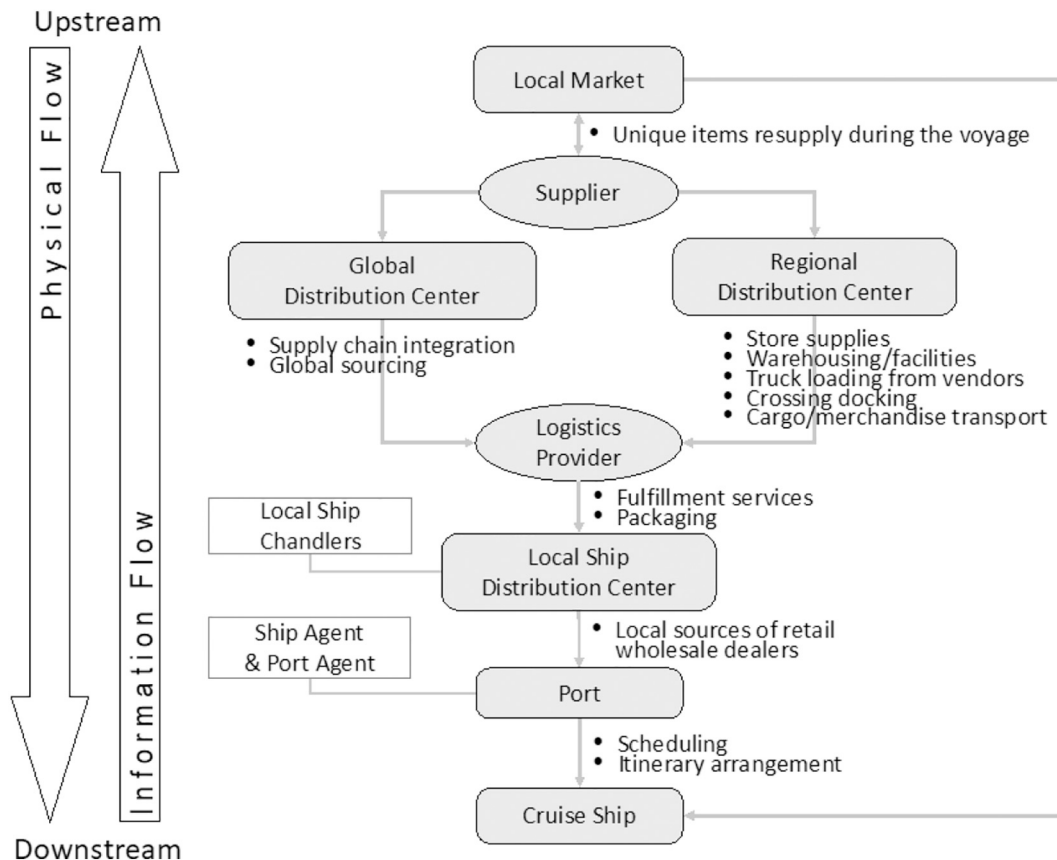


Fig. 1. Information flow and physical flow of cruise supply chain.

cruise lines to establish stable long-term relationships with service providers. Many large suppliers have better capabilities to provide for the short rotation cycle demanded by cruise ships, but cruise ship procurement is much more stringent than the equivalent procurements strategies found in the hotel industry (Zhang et al., 2009). To meet such unusual requirements, cruise lines are more likely to provide incentives when issuing service requests and negotiating contracts with suppliers.

In a broader scope, interconnectivity among various parties and the supply chain management in the tourism industry underlines the complex relationships between actors involved in terms of actions and reactions along with a given set of rules. Such relationships can be found in tourism supply chain coordination between hotels and tour operators (Guo & He, 2012) as well as in the competitive strategies within the tourism supply chain networks, including theme parks, accommodation providers, and tour operators (Huang, Song, & Zhang, 2010). Sakawa, Nishizaki, Matsui, and Hayashida (2012) looked at procurement behavior and inventory management between a food retailer who purchases at central wholesale markets and a distributor who provides local transportation. Given the capacity of a truck, highway express toll, cost of fuel, and budget, revenue distribution between the food retailer and the distributors are simulated. Erkok et al. (2005) found by applying dynamic programming to examine the optimal replenishment strategies for onboard food and beverage items that expedited replenishments were needed at both the origin and the intermediate stops during the cruise voyage.

Ante and post differences in terms of procurement between the number of bookings in a cruise and the realized onboard consumption require well-defined procurement strategies for suppliers who provide perishable goods, which is very different from procurement strategies in the tourism sector. Not only that, but replenishments at turn port are also different from the needed logistics network at the intermediate stops since there is usually no resupply once a cruise has left the turn port, unless for an emergency. Hospitality supply chains, from local upstream suppliers, midstream hotels, restaurants, and retailers, to downstream customers underline how the interconnectivity of stakeholders along the chain can provide for more sustainable sourcing strategies (Xu & Gursoy, 2015). Surveying hotel and restaurant procurement managers, the importance of inter-organizational trust, and relationship quality between partners in the hospitality service chain

were underlined (Shi & Liao, 2013). Similar considerations apply to the culinary tourism supply chains examined through farmers' markets, festivals, and restaurants (Smith & Xiao, 2008).

### 3. The procurement process of cruise ships

Like most procurement processes, supplying cruise ships is subject to various levels of asymmetry in terms of the pricing power of cruise lines and the flexibility of suppliers to meet their requirements. Reliability and price are conventional key drivers in the cruise supply chain. The procurement process between the cruise line and their suppliers can be divided into three stages: information collection, contracting and ordering, and execution stages (Fig. 2).

The first stage is for a cruise company and suppliers to identify the information they need and their motivations, which is a combination of price, quality, flexibility, and timeliness considerations. The cruise company has a good idea of the core parameters of its demand, which is mainly based on an analysis of previous cruises, including their size, duration, seasonality, context, and ports of call sequence. These requirements have an indirect sustainability incentive since the operational characteristic of a cruise ship imposes strict sourcing constraints.

In the second stage, the cruise line designs a quantity-flexible contract with a built-in cash rebate and penalty clauses. Quantity-flexible contracts are considered as a safety net for a cruise company to reduce unforeseen changes in onboard consumption by shifting the risk of inventory holding to the supplier. The main reason why a supplier is willing to assume such a risk is that it can have several alternative customers, such as regional hotels and restaurants, that could purchase the excess inventory while a cruise line would be holding unnecessary and perishable inventory if its cruises are disrupted from a turn port. Often, resupply contracts are signed before the cruise line knows accurate item and quantity numbers since these figures are forecasted and that the total number of passengers on a cruise may be known just a few days before the cruise is expected to start. A wholesale price is paid to the supplier, and rarely item-based negotiations are taking place.

In the last stage, the supplier replenishes the stock based on the placed orders. The cruise line often tends to revise its orders when its ships are about to call at a turn port since it has, at this point, a final perspective of the ship resupply needs. Flexible suppliers will deliver

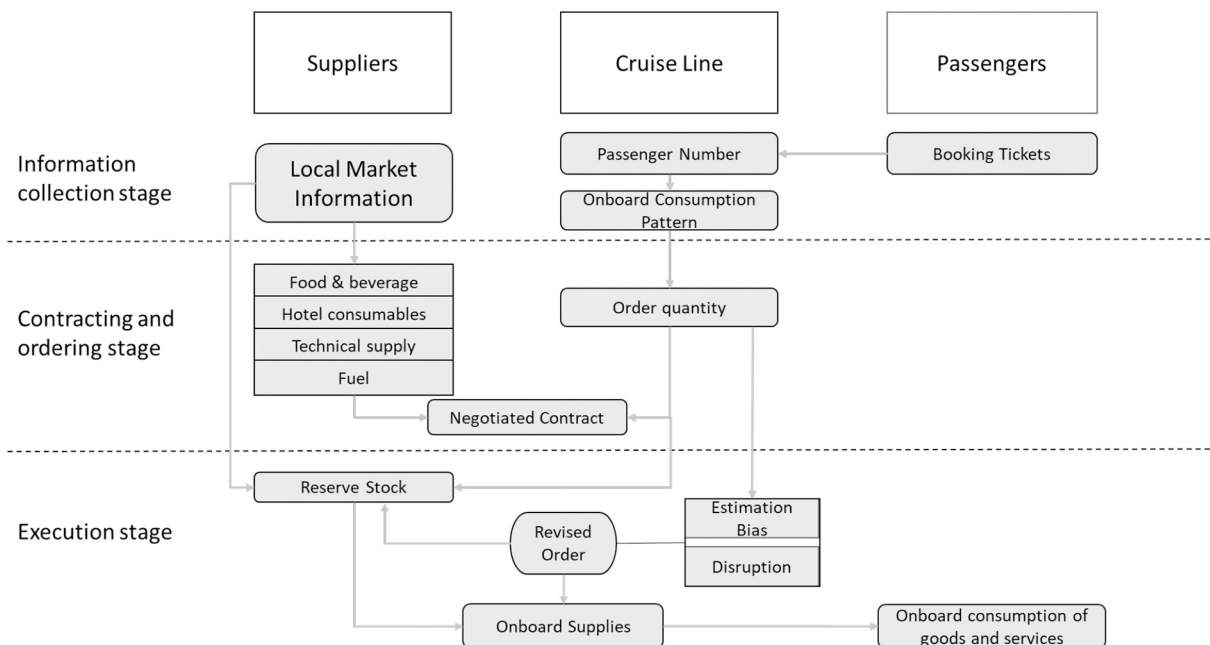


Fig. 2. Stage-wise decision-making process for cruise procurement. Source: Qu, Wang, and Zeng (2019).

based on the revised order and arrange for last-minute deliveries. To achieve this flexibility, a supplier usually holds buffer inventories, leading to higher aggregate inventory carrying costs. On the other hand, if a supplier is not flexible enough, it will face penalties. As a consequence of its unique operational characteristics, cruise supply chains have a higher level of energy intensity than comparable supply chains.

#### 4. Cruise supply chain resilience

The concepts of resilience and reliability are often tied to vulnerability and sustainability. The vulnerability of a transportation system in general and of the supply chain, in particular, could come from the disruption caused by human errors and unlawful acts, unforeseen natural events, or epidemiological risks such as COVID-19. They present risks to the safety and security of passengers and crew, which can also result in a deviation from standard daily operations and the cruise itinerary. Understanding the performance of a system before, during, and in the aftermath of a disruptive event helps improve their planning, mitigation, and sustainability (OECD, 2011). Resilient supply chains are able to provide an efficient response to unforeseen events, and most importantly, are able to recover to an original or improved state after the incident took place (Ponomarov & Holcomb, 2009).

Because of the unique characteristics of cruise ship procurement identified in the previous section, the dynamics of its resilience abide by specific requirements. First, differences between ex-ante and ex-post demand in the cruise supply are not uncommon. A set quantity of supplies based on past observations will be used to forecast the expected demand for future cruises. Real quantity will be realized later in the operating and execution stages of procurement. Deviations from stated quantities could come from the uncertainty of onboard consumption due to unforeseen events. Changes in per passenger consumption in a rough sea cruise (less food and drinks consumed), last-minute changes in the itinerary, or re-routing due to disruptions such as hurricanes add additional complexity to both cruise lines and suppliers. Divergence may also come from the procurement preference of the cruise lines. Some cruise companies need a more significant buffer and require downstream suppliers to hold extra inventory in advance to avoid possible supply disruptions on scheduled cruises to maintain a level of service brand and reputation, which is of paramount importance. Cruise lines are, therefore, very cautious about making sure that the replenishment of a ship is as effective as possible since it is linked with the quality of onboard experience.

One of the most significant selling points of a supplier is the flexibility to meet an unusual or timely request to resupply a cruise vessel. From the cruise line standpoint, flexibility, and willingness to go above and beyond the essential preparation in stock is critical. Reliability and on-time services are essential for cruise operations relying on a strict itinerary and schedule. Cruise lines are fully aware that resupply shortages could not only be financially harmful in terms of additional operating costs, tardiness or insufficient supply may even delay the set schedule and further impact customer satisfaction.

Suppliers that are closer to markets tend to have more information and leeway regarding proper resupply channels if sudden changes in orders or possible unforeseen disruptions occur. Most of the time, suppliers will respond differently when a cruise line makes an unexpected request in changing orders. Some suppliers with low-flexibility may struggle to meet the revised requested quantity since they planned according to the quantity stated in the contract. Further, an event such as a hurricane is not punctual as it impacts turn ports as well as extended areas that may include the procurement ecosystem. In this case, a cruise line may need to rapidly find an alternate supplier to fill the gap, which results in additional costs. Flexibility in view of disruptions may come with additional inventory and distribution costs. However, from the supplier standpoint, a long-term relationship with a major cruise line would be beneficial in terms of profit, marketing strategy, and company reputation. The supplier is better placed to meet the requirements of the

tourism industry at large, particularly special events (large concerts, festivals or sports events).

Incentives and penalty clauses in procurement contracts are used to incite contracting parties to reach mutually beneficial outcomes while pursuing self-interests. Effective incentive strategies will help both cruise lines and suppliers to avoid being largely exposed to supply risks such as resupply shortages, supply inflexibility, and supply disruptions.

#### 5. Factors influencing the procurement process

##### 5.1. Sourcing pattern

Typically, five to ten suppliers are servicing the procurement needs of cruise ships during their turn port calls. The main categories include suppliers of navigational equipment and fuel, product suppliers for accommodation, merchandise suppliers for the retail outlets, and food suppliers for restaurants and bars. The most competitive categories come from supplying machinery, lubricants, or spare parts since they are easily interchangeable. Thus, it is easier to find a supplier that provides parts for the maintenance of a vessel than to find a supplier providing uniforms for the crew. Orders are prepared based on the seasonality and the expected consumption behavior of the passengers on board a specific cruise. Most suppliers have written contracts in terms of the quantity to be supplied, which is subject to seasonality and size of cruise ship assigned along an itinerary. Each cruise ship can have different storage options and capabilities, so the sourcing contract can be ship dependent and states how late revisions may take place. This can range from a week to 24 h before departure, depending on the product and emergencies.

##### 5.2. Pricing

Different pricing strategies towards product suppliers and service suppliers can be seen, ranging from single to bulk, which depends on the nature of the product or service. For example, vessel registration and classification are individually priced with cruise lines offering one negotiable price for the service. Since there is a substantial number of workers on a cruise ship, a cruise line is particularly sensitive to the labor conditions a specific registry allows for its ships. On the other hand, bulk pricing can often be the norm for food and beverage suppliers. It would be counterproductive to negotiate the individual price of each supply item since the price of food, beverage, and alcohol remains relatively constant. Thus, a total package price to stock a vessel is negotiated based upon the estimated number of items per ship rotation. Usually, wholesale prices for the goods in bulk remain the same throughout the contracting period. Prices may be renegotiated after five years and are adjusted for inflation and unforeseen changes in prices.

##### 5.3. Onboard consumption patterns

Onboard consumption patterns are reflective of several factors related to the day of the week, seasonality, as well as culture (consumer preferences) and the demographic composition. For short-duration cruises (2–3 days) on weekdays, conferences and conventions are more prevalent and related to higher consumption per passenger, particularly food and beverages. On weekends, similar length cruises have lower consumption levels since they more involve families and holidays. Cruises having more children are related to the consumption of different food items than cruises having mainly adults. Regarding cultural preferences, Chinese, Japanese and Korean cruisers have a propensity to extensively use onboard restoration and retail services (souvenirs, luxury goods). In contrast, European and North American cruisers tend to spend less on retail, but more at onboard bars. Preferences can become subtle such as wine choice that varies between Europeans and North Americans.

#### 5.4. Delivery patterns

It is uncommon that a supplier delivers the entire purchase order at once. The cruise terminal acts as the final buffer between the supply chain and the cruise ship as inventory is stored on pier (or near pier) warehousing facilities. The reliability of a supplier is based on the share of items that are delivered on time and constrained by the unique characteristic that a cruise ship needs to be resupplied during its short rotation time. In the case when a supplier is not able to fully meet an order, deliverable substitutes will be improvised. If this fails, a penalty may apply, such as the cost to source a similar item from another supplier, but such practice is uncommon. Cruise lines prefer to store excess inventory on the vessel since they tend to have ample stores. In a situation of over-supply of items at the terminal, the delivery of these items will be revised, and suppliers may even be asked to restock additional inventory. Suppliers tend to be flexible to accommodate the needs of cruise lines since their purchasing power is similar to a large regional retailer or hotel chain. A form of flexibility is the ability to provide alternative delivery options than at the turn port. Although this is not a regular practice, it takes into account contingencies in case of disruptions at the turn port (e.g., its closure). Since suppliers tend to be global firms, supply contracts also include a list of alternative ports where supplies (with more limited choice) could be delivered, mainly if those ports are part of itineraries or involving a low deviation.

#### 5.5. Anthropogenic, epidemiological and natural disruptions

Anthropogenic disruptions in the cruise supply chain are mainly tied to safety and security concerns. Cruise accidents are considered the most critical driver. Using data from 2003 to 2012, Wang, Zeng, and Ghoram (2018) categorized incidents into six categories, such as itinerary change due to mechanical malfunctions, mechanical problems, collisions, fire, propulsion and steering problems, and other causes. Many of these are within the control of cruise lines and can be mitigated with better equipment, maintenance, and training.

Unlike anthropogenic disruptions, natural disruptions mainly concern unforeseen weather events altering cruise schedules. They are outside the control of cruise lines but can be assessed in terms of seasonality and probability based on the weather forecast. At the intersection between anthropogenic and natural disruptions, epidemiological disruptions have been an enduring concern for the cruise industry. The norovirus, with its gastroenteritis outcome, is a recurring event on cruises, at times impacting 5 to 10% of the passengers. Close quarters, common areas (dining rooms, hallways, sundecks), and air circulation systems are the main risk factors. The COVID-19 pandemic placed these risks at the forefront with cruise ships such as the Diamond Princess, with more than 700 cases out of 3700 passengers and crew in the early stages of the pandemic.

It is difficult to come out with standard mitigation strategies during a disruption since it depends if the disruption is within the ship only, on the number of ports of calls impacted, and if the turn port is involved in the disruption. Having a turn port involved in a disruption is particularly damaging since it involves the disruption of the cruises, the accessibility of the customer base to the turn port as well as the cruise ship procurement. Cruise lines have developed their managerial response strategies accordingly with an 'ad-hoc standardization'; the responses are usually the same but contingent upon the circumstances. Utilizing value-added pricing strategies to cope with service providers is quite common in the case when an emergency supplier or back up suppliers are needed.

### 6. The response of cruise lines to disruptions: The case of the Caribbean

#### 6.1. The Caribbean cruise market

The Caribbean is the world's most important cruise market

accounting for about 45% of all the deployment of the cruise fleet capacity in bed-days. The suitability of the Caribbean for cruises is the outcome of several factors (Rodrigue & Notteboom, 2013; Wood, 2000). From a geographical standpoint, the Caribbean is an archipelago, including many small nation-states that are in proximity, which supports short distances between ports of call along an itinerary. This is also linked with a subtropical climate with limited fluctuations in temperature, making the market accessible year-round, but with a hurricane season from August to October.

The Caribbean has a long history associated with European colonialism and accounts for the oldest settlements in the Americas, conferring a very diversified cultural landscape that often varies significantly from one island to the other. It can offer a variety of cultural experiences in proximity. Being adjacent to the United States provides a large market of potential tourists able to afford Caribbean cruise packages accessible through large turn ports such as Miami, Fort Lauderdale or Port Canaveral. All are near major airports well connected to the rest of the United States and major touristic destinations. Outside the primacy of these turn ports, cruise lines are developing secondary turn ports such as Galveston and New Orleans for cruises calling the Western Caribbean market. The goal is to maximize market access both for the cruise options and the customer base.

#### 6.2. Hurricane alley

The Caribbean is within a zone of high hurricane activity over the Northwest Atlantic that has been dubbed 'Hurricane alley' because it is shaped like a corridor beginning in the Atlantic north of the equator and following westward the Gulf Stream towards the Caribbean, the Gulf of Mexico and the American East Coast where hurricanes reach their full force and then dissipate as they move northward (Fig. 3). The seasonal occurrence mainly takes place between June 1 and November 30, with hurricane activity usually peaking in September. During a hurricane event, forecast of arrivals and warnings, possible storm surges, high wind speed, possible tropical rainfall are critical and could disrupt a cruise and change onboard demand of services. Southern Florida, which is one of the world's largest cruise markets with its major turn ports (Miami, Fort Lauderdale, and Port Canaveral) in an area of recurring hurricane risk.

Despite this demonstrated risk pattern, the frequency, intensity, and the path of a hurricane cannot be reliably known until a day or two beforehand. There are annual fluctuations with some years seeing limited hurricane activity while on others, hurricanes are more frequent and disruptive. The path followed by a hurricane is an excessively important and somewhat unpredictable factor. The same hurricane following a slightly different path could result in a very different disruptive outcome. Under such circumstances, cruise lines rarely cancel cruises, but instead change the sequence of port calls to avoid the expected path of a hurricane, which involves last-minute decisions during a cruise. A highly disruptive exception is when a turn port is under the path of a hurricane, leading to the cancellation of incoming cruises and the re-routing of ongoing cruises to another turn port. Cruise lines have adapted to this by offering the least number of cruises during the peak hurricane season of September (Fig. 4). Even if the Caribbean is a perennial cruise market, the risk of hurricanes and tropical storms has a noticeable impact on the offering of cruises during the hurricane season.

#### 6.3. A disruptive 2017 hurricane season

Three back-to-back significant Caribbean hurricane events occurred in 2017, which had been illustrative of the response dynamics of cruise lines. Hurricane Harvey (August 17 through September 2; reached category 4) affected the Houston area and the cruise port of Galveston, while Florida-based cruise operations were impacted by Hurricane Irma (August 30 through September 13; reached category 5), which forced the closing of the Miami / Fort Lauderdale cruise ports. Hurricane Maria

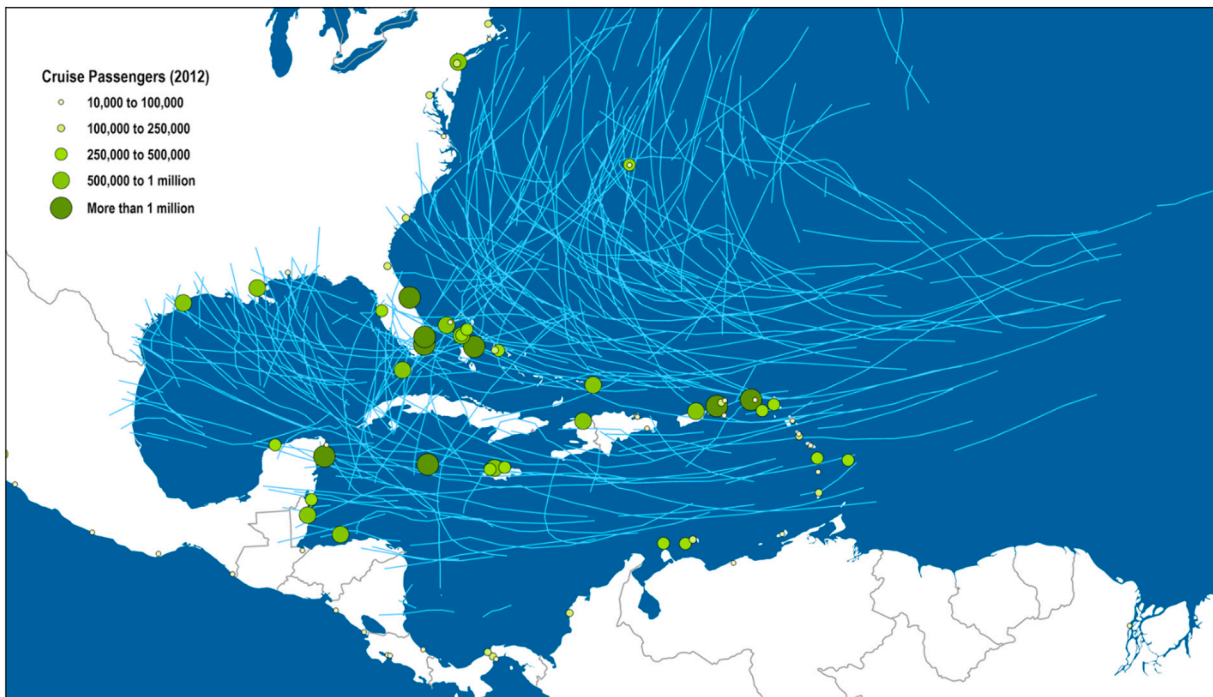


Fig. 3. Cruise passengers handled at Caribbean ports (2012) and path of Atlantic Hurricanes above Category 3 (1900–2009).

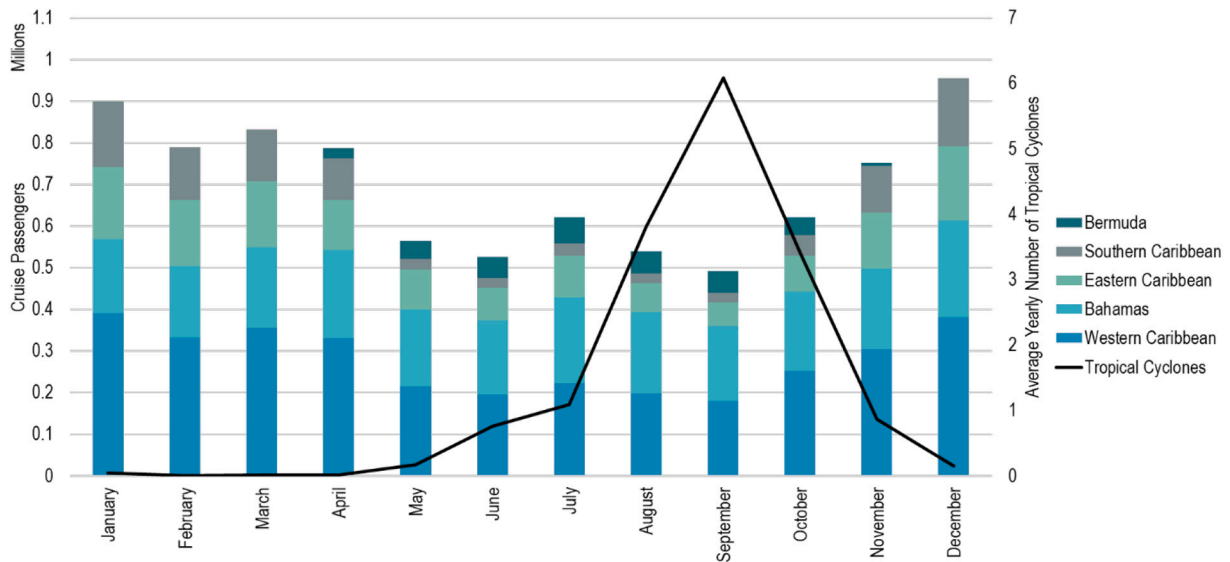


Fig. 4. Number of monthly North American Cruise passengers in the Caribbean (2011) and average yearly number of Atlantic Tropical cyclones. Sources: US Department of Transportation, Maritime Administration. NOAA Hurricane Research Division. Based on observations between 1851 and 2018.

(September 16 through October 2; reached category 5) had significant impacts in the Caribbean and is considered the worst natural disaster on record in Dominica and is responsible for catastrophic damage leading to a humanitarian crisis in Puerto Rico. Hurricane Harvey was tied with Hurricane Katrina (August 23 to 31, 2005) for being the costliest hurricane on record with an estimated cost of \$125 Billion.

The level of disruption of a hurricane event on the cruise industry can be assessed by comparing the number of annual visitors along the hurricane path with the total visitors in the region. A geodatabase containing the number of passengers handled at all the cruise port of calls in

the world was compiled from data provided by Cruise Market Watch.<sup>1</sup> This geodatabase was overlaid with a geodatabase of the hurricane paths of Maria, Irma, and Harvey provided by the National Hurricane Center (a branch of U.S. Dept of Commerce, National Oceanic and Atmospheric Administration<sup>2</sup>). Hurricane Maria impacted cruise ports that accounted for 41.6% of the cruise visitors in the Caribbean, while this share was 68.7% for Hurricane Irma (see Fig. 5). Thus, due to the distribution and linear orientation of the Caribbean islands, a slight change in a hurricane path can result in a significant change in the impacts on cruise

<sup>1</sup> <https://cruisemarketwatch.com/cruise-pulse/>

<sup>2</sup> <https://www.nhc.noaa.gov/gis/>

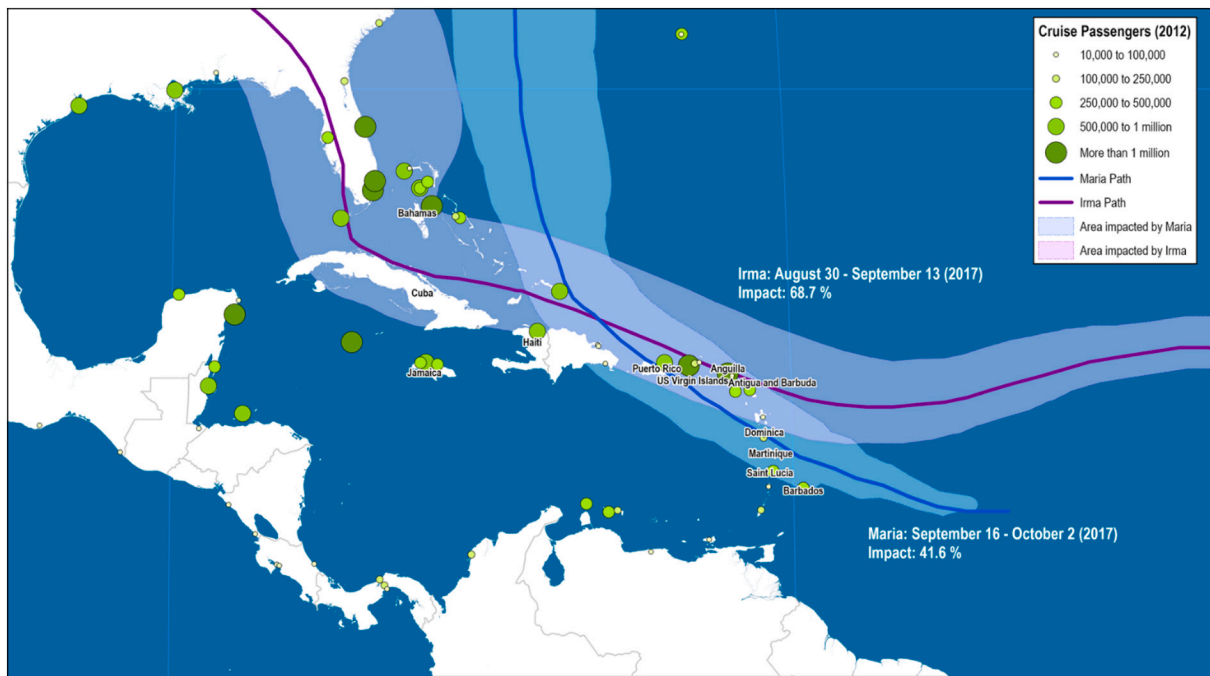


Fig. 5. Impacted Caribbean areas and cruise destinations by hurricanes Irma and Maria.

operations, as noted between Hurricane Maria and Irma. Hurricane Maria bypassed the Southern Florida and Bahamas cruise cluster.

6.4. Turn port disruption and cruise line resilience: the case of Galveston, Texas

Galveston hosts Carnival, the world’s largest cruise line, which uses its cruise terminal facility to draw customers from the sizeable Texan market as well as being close to the major airport of Houston. In August 2017, Hurricane Harvey hit Texas and seriously hindered cruise operations since the main turn port of Galveston was shut down from August 25 to September 1. This hurricane left three Carnival cruise ships unable to return to their scheduled turn port and re-routed to New Orleans.<sup>3</sup>

Additionally, one Royal Caribbean cruise ship scheduled to call Galveston was diverted to Miami. Each of these ships carries about 3000 passengers. The Carnival Valor and Carnival Freedom were diverted to New Orleans to disembark passengers and for restocking. With approximately half of the passengers staying on board, both cruise ships replenished with fuel, food supplies, and other supplies. The Carnival Breeze was forced to extend its stay in Cozumel, Mexico, and had to be re-routed to New Orleans as well.

Fig. 6 illustrates the scheduled (A) and diverted paths (B), including repositioning, of the three cruise ships mentioned above. The event imposed an additional 18.6% nautical miles traveled for the three cruise ships, including the repositioning. Cruise cancellations continued due to storm, while cruise ships sailed back to the port. The Carnival Freedom and the Carnival Breeze had to cancel sailings scheduled on August 26th and 27th and resumed their services on September 2nd and 3rd. The Carnival Valor had to cancel sailings on both August 26th and 31st due to the storm. About 20,000 cruise passengers could not disembark at the scheduled time on August 26th and 27th. Similar events took place following Hurricane Irma, where 15 cruises were canceled, and nine were delayed coming out of Miami, impacting about 75,000 cruisers.<sup>4</sup>

<sup>3</sup> Gajanan, M., Hurricane Harvey Has 20,000 Cruise Ship Passengers Stuck at Sea, August 25, 2017, TIME.

<sup>4</sup> Hurricane Irma: A complete list of cruises canceled, delayed, September 6, 2018, USA Today.

Based on the evidence reviewed, a hurricane increases the cost of an ongoing cruise, including additional fuel consumption, by a factor of 20 to 25%.

The risk exposure to cruise operation can also be seen from the perspective of ship deployment. The service schedule of the Carnival Breeze in 2018 underlined the potential risks and challenges of deploying cruise ships on Caribbean itineraries (Fig. 7). The cruise ship used two turn ports to begin Caribbean itineraries, Galveston and Port Canaveral, which were called 38 times and 13 times, respectively. Calls were spread through the Caribbean’s sub-markets with multiple calls at small private islands with co-investment in those destination ports. The geographical distribution of port calls as well as a multiple (dual) turn port strategy gives cruise lines opportunities to minimize unforeseen disruptions during hurricanes. Thus, despite the risks, cruise lines are building sustainable business practices focusing on the adaptability to the unique hazard conditions of the Caribbean.

7. Conclusions and managerial implications

The impressive growth of the cruise industry provides additional pressures for more effective and sustainable procurements of cruise ships during their short duration port turns. Cruise ships have increased in size, and the consumption of onboard services has become more diversified. The selection of a turn port thus takes into consideration not only the regional market potential to attract customers, airline connectivity and hotel amenities, but the presence of an ecosystem of suppliers able to provide for the specific procurement needs of cruise ships. The procurement process and the related contracts reflect these requirements, and it remains to be seen in which way sourcing strategies will become more sustainable. The fact that the United States has advanced logistical services makes procurement and resupply much more effective than in a developing economy. This efficiency underlines why there are usually few turn ports in such markets, even if they are usually the main travel areas and have good air connectivity and hotel amenities because of existing mass tourism.

Natural disruptions can incur high costs for cruise lines and their suppliers. As such, pursuing lower procurement costs in line with conventional supply chain management practices does not reflect well the



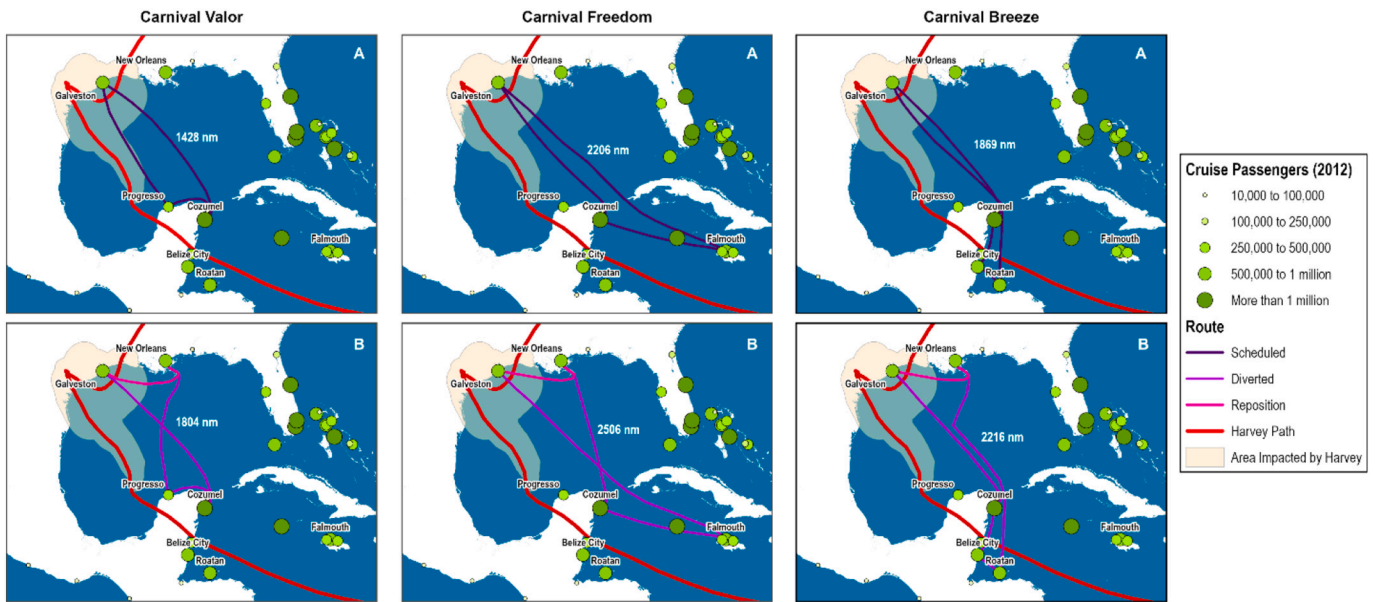


Fig. 6. Three Carnival cruise ship deviations during Hurricane Harvey (August 2017).

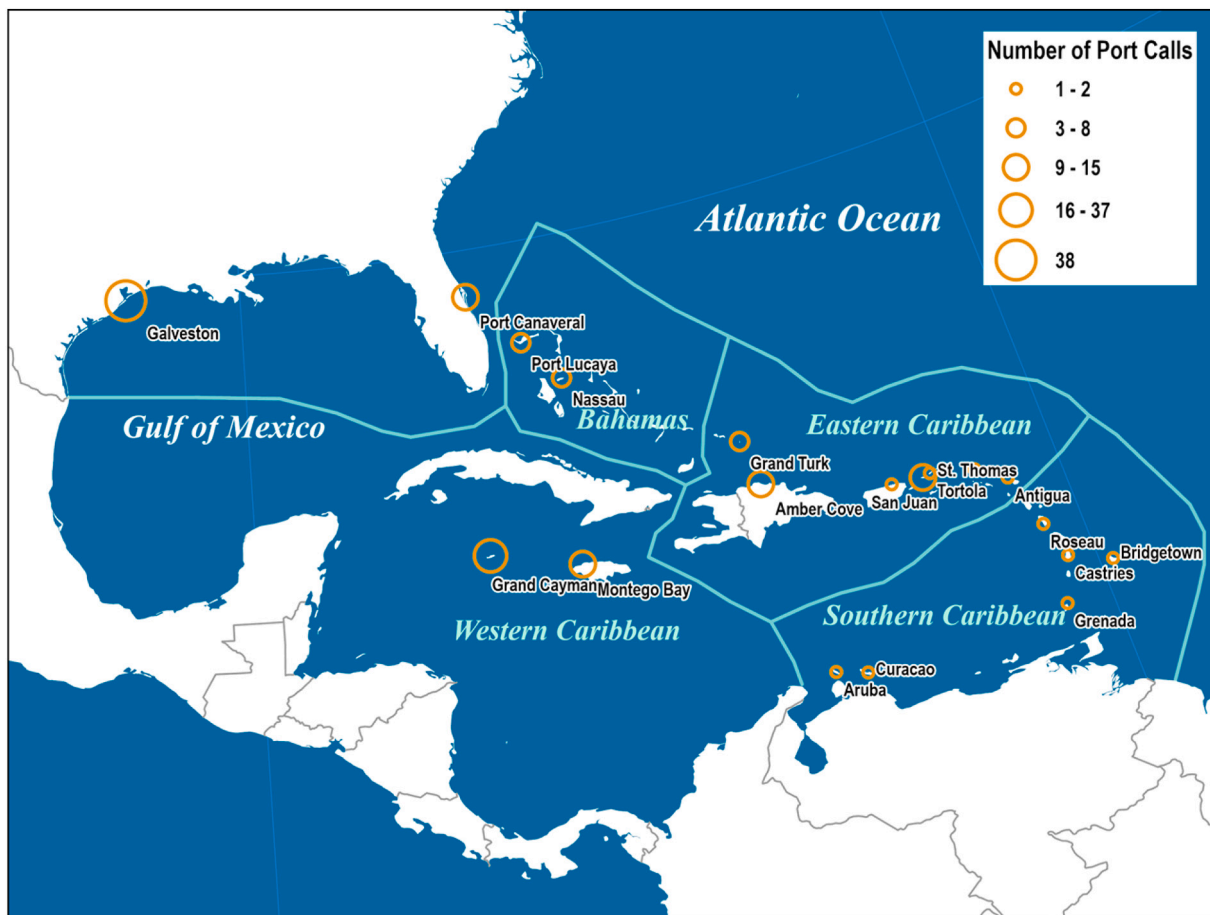


Fig. 7. Carnival Breeze port calls, 2018. Source: Compiled by authors from the [crew-center.com](http://crew-center.com)

current operational environment and uncertainties of cruise shipping. It is more important to aim at the common ground between cost-saving and incentive mechanisms to prevent disruptions. Therefore, cruise lines have developed strategies to cope with disruptions in the case of hurricanes through ad-hoc standardization. The main managerial

implications include:

- Reducing the number of cruise offerings during peak hurricane season (standard practice).

- Deploying ships across several turn ports and with varied itineraries (standard practice).
- Curtailing current trips and re-route ships away from the path followed by hurricanes by changing ports of call (common).
- Changing the turn port and ship resupply to an unimpacted location (occasional).
- Activate ships to bring supplies and humanitarian aid to remote areas such as islands (rare).
- Offering evacuation cruises out of areas about to be impacted, mainly if they are turn ports (occasional).
- Activating ships as floating hotels and restaurants, particularly for aid workers (rare).

The above events create uncertainty in the purchase orders and require suppliers to work closely with the management of the cruise company to provide needed consumables promptly. Apart from voluntarily humanitarian services and corporate social responsibility offered by cruise lines, curtailing current trips and re-route of vessels could raise concerns and come at a high monetary cost in terms of lost cruise income.

If the expectation of more frequent and intensive natural disruptions such as hurricanes due to climate change is unfolding, cruise lines servicing the Caribbean will further need to adopt mitigation strategies so that they can maintain continuous cruises (revenues) sustainably. The additional risks will be compensated by flexible procurement processes, which will be reflected in the contractual terms with suppliers. The cruise industry represents a unique example of the sustainability and climate change challenges facing the tourism industry, with the main actors constantly shifting strategies to maintain their operations, considering the risk of disruptions while maintaining a high level of onboard customer satisfaction. The COVID-19 pandemic underlined a new set of vulnerabilities for the cruise industry, which was deeply impacted by the bulk of the industry shutting down for most of 2020. In the initial phase of the pandemic, cruise ships underlined that they were an environment highly susceptible to the spread of communicable diseases. This issue is going to generate ample research opportunities about the adaptation of cruise ships and their supply chains to a set of epidemiological risks that are likely to endure.

#### Disclaimer

The co-author is the director of economic studies at the Federal Maritime Commission, which regulates United States foreign commerce by ocean. The opinions and ideas in this paper are the author's own and do not represent the views of the Federal Maritime Commission or the U. S. Government.

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