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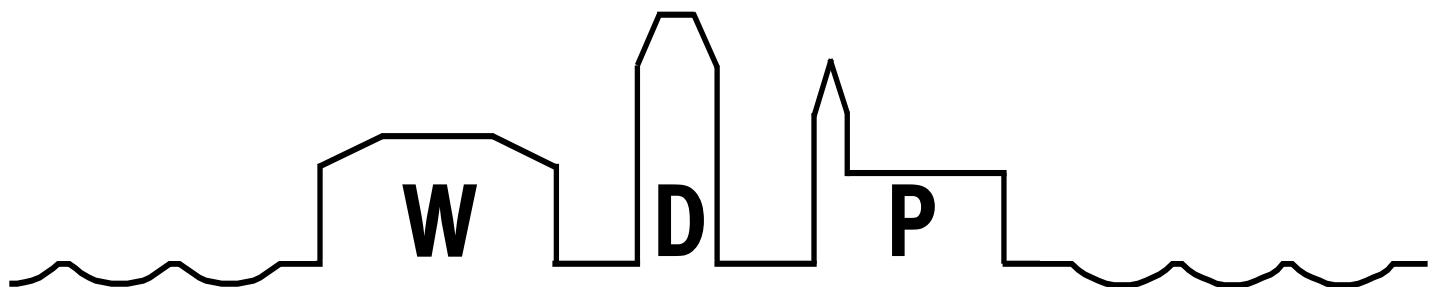


Fakultät für Wirtschaftswissenschaften
Wismar Business School

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The Maritime Perspective of Latin America

Heft 03/2025



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Vorwort

Das Interesse an Lateinamerika unter maritimen Gesichtspunkten erfreut sich steigender Beliebtheit. Dabei spielt nicht nur der Panamakanal eine herausragende Rolle, sondern auch neuere Entwicklungen so wie der erst 2024 eröffnete Containerhafen Chancay in Peru, der für viele Diskussionen sorgte. Schaut man sich aber in der wissenschaftlichen Literatur zu Veröffentlichungen zum Thema der maritimen Wirtschaft in Lateinamerika um, so ist die Menge der Publikationen eher rar gesät und wird der wachsenden Rolle Lateinamerikas nicht gerecht. Hinzu kommt, dass davon auszugehen ist, dass im Rahmen der Annäherung zwischen der EU und dem Mercosur der Austausch zwischen Europa und Lateinamerika weiter an Bedeutung gewinnen wird, obwohl momentan noch ca. 90% die maritimen Transporte auf der nördlichen Hemisphäre verlaufen. Hier soll das Heft eine erste Orientierung liefern und dem interessierten Leser die Annäherung an das Thema „Maritime Perspectives of Latin America“ erleichtern.

Dabei soll das Heft helfen eine umfassende, datengestützte Analyse der aktuellen und zukünftigen maritimen Landschaft Lateinamerikas zu liefern. Es beginnt mit der Untersuchung der Demografie, der Geographie und des allgemeinen wirtschaftlichen Überblicks über die Makroregion „Lateinamerika“. Anschließend wird die bestehende maritime Infrastruktur bewerten, die wichtigsten wirtschaftlichen und maritimen Hotspots identifiziert und das zukünftige Seeverkehrsvolumen und der Bedarf an maritimer Transportfähigkeit (DWT) bis 2050 prognostiziert. Basierend auf den Ergebnissen dieser Analyse werden Empfehlungen für neu gebaute Schiffe nach Typ und Ladung sowie der weltweite Bedarf an Schiffbaukapazitäten und die strategische Entwicklung neuer Werften in Lateinamerika vorgestellt. Im Anschluss daran werden wichtige Überlegungen zur Antriebstechnologie und zu zukünftigen Schiffskraftstoffen für lateinamerikanische Schiffe unter Berücksichtigung der aktuellen Infrastruktur und der zukünftigen Kraftstoffprognosen behandelt. Das Heft endet einem strategischen Entwicklungsplan für den Ausbau der maritimen Infrastruktur sowie die bessere Integration Lateinamerikas in das globale maritime Transportnetz 2050.

Die folgende Publikation hat ihren Ausgangspunkt in Seminararbeiten, die im Studiengang „Operation and Management of Maritime Systems“ im Sommersemester 2025 in Warnemünde stattgefunden haben. Dort hatten die Studenten im Modul „Management in Shipbuilding“ die Aufgabe in Gruppen im Rahmen eines „Problem Based Learning“ Ansatzes Ausarbeitungen zum Arbeitsthema „Maritime Latin America“ zu erstellen und vorzutragen. Die Aufgabe wurde von den Studenten mit so großem Enthusiasmus und Engagement durchgeführt, dass die gesammelten Ergebnisse es wert waren der Öffentlichkeit in Form einer WDP-Publikation präsentiert zu werden. Hierzu wurden die Ergebnisse der Gruppenausarbeitungen überarbeitet, ergänzt und erweitert, so dass dieses Heft im Rahmen der WDP-Reihe der Fakultät für Wirtschaftswissenschaften der Hochschule Wismar entstehen konnte.

Großer Dank gebührt für die Entstehung des Heftes zunächst erst einmal den beteiligten Studenten des Studienganges OMMS2024 für ihre Beiträge, nämlich den Studenten Minnu Ajith, Prakash Angamuthu, Vinaysinh Chikaliya, Rasmus Feldstein, Shajee Hassan, Sandra Maffock, Alfin Martin, Finn Mehrens, Kristinya Obeye, Alexander Pahlitzsch, Fahad Ramzan, Mojtaba Sajadian, Athul Sajeev, Ashik Samuel, Abhinav Theruvath, Sreerang Unnikrishnan, Johnson Uthuppan, Jomin Varghese, Jericho Wicaksonohne, deren Einsatz das Heft gar nicht entstanden wäre.

Darüber hinaus bin ich zu großem verpflichtet den Herrn Sayyed Shahzeb Hussain und Alireza Seifnouri, die in vorbildlicher Weise die Texte zusammengetragen und editiert haben und ohne deren enthusiastischen Einsatz dieses Heft niemals entstanden wäre. Und schließlich und endlich gebührt mein Dank Frau Dr. Eunice Omolola Bark für ihr zur Verfügung gestelltes Wissen zum Thema, ihre Ergänzungen und ihre Lektoren-Tätigkeit.

Mögen alle Leser des Heftes genau viel Spaß an der Lektüre haben wie wir in der Entstehungsphase.

Wismar, im September 2025

Gunnar Prause

1. Economic Development and Global Integration

Latin America is increasingly recognized as a pivotal economic macro-region and a significant source of natural resources on the global stage [1] just as maritime transport plays a fundamental role in this economic development and global integration [2]. With over 25,000 kilometers of combined coastline along the Pacific and Atlantic Oceans, the continent's geography is inherently maritime. More than 90% of South America's international trade by volume is carried by sea, underscoring the importance of efficient and resilient maritime infrastructure [1].

Maritime infrastructure comprising ports, shipyards, inland waterways, and logistics systems serves as the physical foundation for this trade. However, the quality and capacity of this infrastructure vary significantly across the region. While some countries boast modern, high-performing ports and digital systems, others face challenges related to congestion, aging facilities, limited intermodal connections, and insufficient investment [3].

Despite this growing importance, the current global maritime transport landscape remains heavily concentrated in the Northern Hemisphere, with approximately 90% of maritime transport occurring there. This leaves only about 10% of maritime transport directed North-South or circulating within the Southern Hemisphere, a notable disparity given Latin America's economic weight and resource endowments. The premise of sustained economic growth in the Northern Hemisphere until 2050 suggests that maritime cargo streams to and from Latin America are expected to expand significantly, driving a corresponding increase in demand for maritime cargo transport over the coming decades [4].

The current disproportionate share of global maritime transport for Latin America, as explicitly noted in the user query, indicates a substantial untapped potential for growth within the region's maritime sector. This situation suggests that existing maritime infrastructure, established trade routes, and current fleet capacities are not fully aligned with Latin America's emerging economic influence. The opportunity presented is not merely one of incremental growth but rather a strategic rebalancing of global maritime flows, allowing Latin America to assume a more central role in international trade. This mirrors historical patterns observed in other developing regions, such as Africa, which has also faced similar marginalization in global sea trade despite its potential [5].

1.1. Population and Demographics

The demographic profile of Latin America and the Caribbean presents a dynamic picture, characterized by evolving growth patterns and a significant shift in age structure. Understanding these trends is fundamental to projecting future demand for maritime transport and related services. In 2024, the population of Latin America and the Caribbean reached approximately 663 million people [6]. This

figure, however, is 3.8% lower than the 689 million initially projected in 2000. This deviation from earlier forecasts can be attributed primarily to lower-than-anticipated fertility and mortality rates, coupled with an increased volume of migration flows in recent years, as well as significant demographic changes observed during the COVID-19 pandemic [7].

Projections and Growth Trends to 2050

Looking towards the future, the region's population is projected to reach its peak at approximately 730 million in 2053 [8]. While this indicates continued growth, the annual population growth rate has been on a continuous decline since the mid-1960s, a trend that has accelerated faster than initially anticipated by the 2000 revisions [7]. When compared to a 2000 baseline (Figure 1), Latin America and the Caribbean are projected to experience a 40% population increase by 2050, reaching 0.7 billion people. This growth rate is notably slower than that projected for Africa, which is expected to see a 212% increase to 2.5 billion people over the same period, but still higher than in China [9].

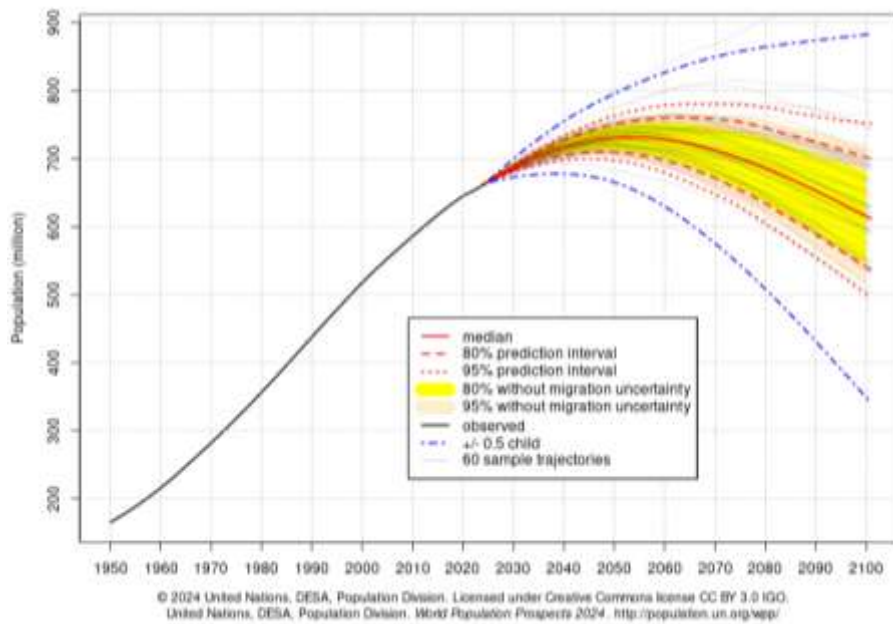


Figure 1. Latin America and Caribbean: Total Population Prospects / Source UN [10].

This slower population growth in Latin America, particularly when contrasted with Africa's more explosive demographic expansion, suggests a different trajectory for increased demand in maritime transport. While Africa's demand might be driven by sheer volume from a rapidly expanding, young population, Latin America's growth, though more moderate, is accompanied by a rapidly aging population and increasing urbanization. This demographic shift implies that the nature of future demand for maritime transport may be more nuanced. Instead of a uniform surge in basic consumer goods, there could be a more targeted increase in demand for specific types of imports, such as healthcare products e.g., pharmaceuticals, which often require temperature-controlled reefer containers [11] and specialized

services tailored to an older demographic. This observation, together with continuously high demand for raw material and agriculture products from Asia and Europe, also suggests a potential evolution in the labour force structure and consumer spending patterns, influencing the types of cargo and the sophistication of logistics required.

Urbanization Rates and Trends

Urbanization is a defining characteristic of Latin America's demographic landscape. Currently, approximately 80% of the population in Latin American countries resides in urban areas, a proportion higher than in most other global regions. After a period of sharp growth, urbanization in the region is now showing signs of moderation, with future expansion expected to occur at a pace below the world average (Figure 2).

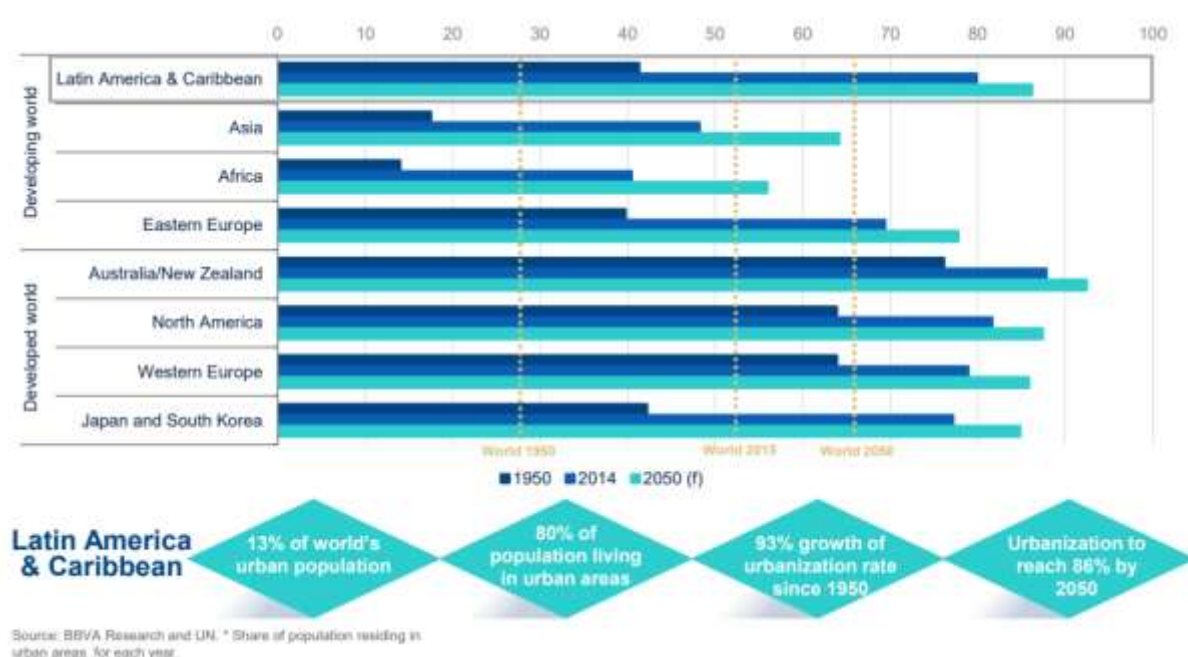


Figure 2. Share of urban population by regions in percentage of the total population /

Source *Latin America Economic Watch: Urbanization* [12].

Median Age and Demographic Dividend Potential

The median age in Latin America and the Caribbean has undergone a significant transformation. From a median age of 18 in 1950, it rose to 31 years in 2024 and is forecast to reach approximately 40 years by 2050 [6]. This aging trend is further underscored by projections indicating that by 2050, about 18.9% of the region's population will be over 65, nearly double the 9.9% observed in 2024. This translates to an increase from 65.4 million people over 65 in 2024 to an estimated 138.0 million in 2050 seen in Figure 3.

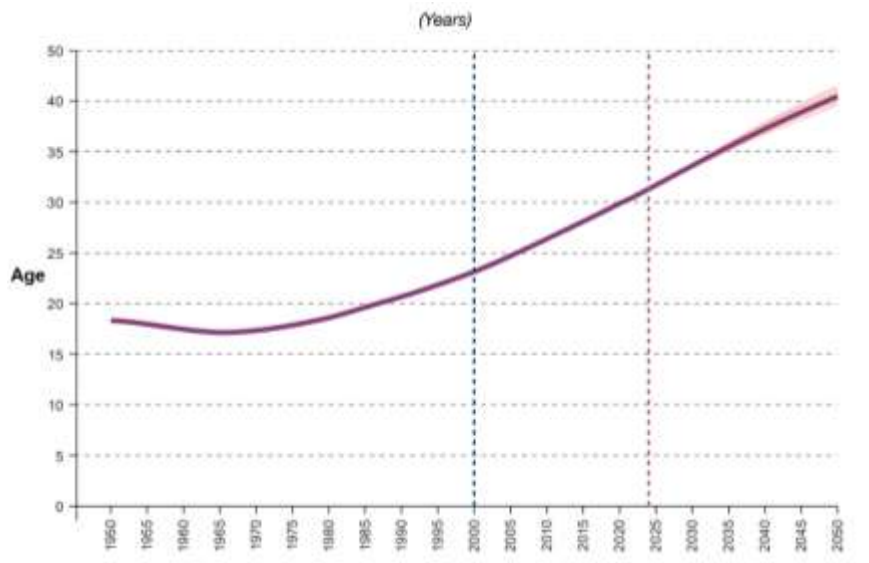


Figure 3. *Latin America and the Caribbean: median age of population, 1950-2050* / Source ECLAC [7].

This demographic shift, marked by a rapidly aging population, presents both challenges and opportunities. A higher proportion of older individuals typically implies a higher dependency ratio, where a smaller working-age population supports a larger number of retirees that can impact economic growth and public services. However, it also suggests a potential for increased demand for imports related to healthcare, leisure, and specialized consumer goods which is a demographic evolution that could influence the types of cargo transported, potentially leading to a greater emphasis on high-value, temperature-controlled, or specialized goods. Furthermore, a maturing workforce might necessitate greater adoption of automation in port operations and logistics to maintain efficiency, as the availability of cheap labour could diminish.

1.2. Labor Force Dynamics and Employment Sectors

In 2024, Latin America's labour force comprises approximately 332 million people, with a significant concentration of 274 million in urban areas. Projections indicate that the urban labour force will continue to grow, reaching 337 million by 2050 (out of a total projected labour force of 395 million), while growth in the rural labour force is expected to stagnate, a trend already evident over the past decade [7], the also boasts a high literacy rate, recorded at 94.60% for Latin America and the Caribbean in 2022 [13].

The combination of high urbanization, a growing urban labour force, and a high literacy rate suggests a workforce that is increasingly skilled and diversified. The stagnation of the rural labour force further indicates a continued structural shift away from purely agricultural employment towards more industrialized and service-oriented sectors. This demographic characteristic points to a significant potential for growth in higher-value manufacturing, services, and technology sectors within the region. Such a shift could lead to a diversification of maritime cargo beyond raw commodities, emphasizing

finished goods and components that could boost a more educated workforce that is better positioned for technological adoption and further facilitate the implementation of advanced solutions in the maritime and logistics sectors, such as port automation and digital logistics platforms.

1.3. Geostrategic positioning of Latin America

The diverse and complex geography of Latin America plays a profound role in shaping its economic development, internal connectivity, and external trade relationships, particularly concerning maritime transport.

Latin America is broadly segmented into three primary geographic regions: **Central America**, the **Caribbean**, and **South America** [2]. **Central America**, a narrow land bridge, serves as a crucial isthmus physically connecting the North and South American continents [9]. South America itself is the fourth largest continent by land area and the fifth most populous globally, bounded by the vast Atlantic Ocean to the east and the Pacific Ocean to the west [10].

Key Physical Features

The landscape of Latin America is characterized by several prominent physical features that influence human activity and infrastructure development [14, 15]:

- *Mountain Ranges*: Dominating the western spine of the continent are extensive mountain systems. The Sierra Madre mountains traverse Mexico and Central America, while the formidable Andes Mountains stretch along the entire western coast of South America, forming the longest continental mountain range outside of Asia.
- *River Basins*: A region that is home to some of the world's largest and most vital river systems. The massive Amazon River Basin and its accompanying Rainforest, primarily in South America, represent the second-largest river in the world, notably without any bridges crossing it along its vast expanse. Other significant rivers include the Orinoco and Parana Rivers.
- *Deserts*: In stark contrast to the lush rainforests, the Atacama Desert in Chile stands as one of the world's driest places.
- *Highlands and Plateaus*: Important elevated landforms include the Central Plateau in Mexico, the extensive Brazilian Highlands, the Guiana Highlands, and the fertile Parana Plateau in southern Brazil.

Significant Maritime Features

Latin America's extensive coastlines and strategic waterways are critical for its engagement in global trade such as the following:

- *Coastlines and Major Water Bodies*: The region boasts vast coastlines along both the Atlantic and Pacific Oceans, as well as the Caribbean Sea and the Gulf of Mexico [14]. These provide direct access to major global shipping lanes.

- *Canals*: The Panama Canal, a monumental engineering feat, connects the Pacific and Atlantic Oceans across the Isthmus of Panama.¹⁰ Its expansion in 2016 significantly enhanced its capacity, allowing vessels to carry up to three times more cargo than before [16].

The geographical advantages of Latin America, particularly its access to two major oceans and the strategic Panama Canal, are clear benefits for global maritime connectivity. This positioning enables efficient trade with both Eastern and Western markets. However, the continent's formidable internal geography, characterized by vast mountain ranges like the Andes and Sierra Madre, and expansive river basins such as the Amazon, presents significant challenges for internal hinterland connectivity. These natural barriers complicate the efficient movement of goods between coastal ports and the resource-rich interiors or densely populated urban centres.

Even though trade and uniting countries in the region become easier, the region also deals with security matters like illegal fishing, drug trafficking and environmental threats. For this reason, we should establish joint strategies in the region and cooperate closely globally, focusing especially on dangerous places such as Ecuador's Pacific coastline and the southern part of the Atlantic [17]. Furthermore, the Panama Canal's vulnerability to climate disruptions, such as droughts that reduce water levels and force ships to take longer, more expensive routes, underscores the critical need for alternative or diversified maritime routes and the development of climate-resilient port infrastructure across the region [18].

In other words, although the Latin America is well-positioned for international trade, internal trade and logistics it often encounters substantial natural obstacles that requires developing efficient multimodal transport connections including modernized roads, expanded railway networks, and optimized waterways that can effectively traverse these geographical challenges is paramount. Such development is crucial for unlocking the full economic potential of the interior regions and integrating them seamlessly into maritime supply chains.

1.4. Overview Major Economic Sectors and Their Contribution

Latin America's economic landscape is characterized by its substantial contribution to global output, its reliance on key sectors, and ongoing efforts towards regional integration. These factors collectively shape its maritime trade dynamics.

In 2021, Latin America and the Caribbean collectively accounted for 7.3% of the global Gross Domestic Product (GDP), while representing 8% of the world's population. Within the region, Brazil and Mexico stand out as the two largest economies. In 2021, Brazil's GDP was estimated at \$3.7 trillion, and Mexico's at \$2.7 trillion; together, these two nations contributed 57% of the region's total GDP. The average real GDP per capita for Latin America and the Caribbean in 2021 was \$18,560, which, while indicating significant economic activity, remained below the global average of \$20,271. This figure also masks considerable economic heterogeneity among the countries within the region [19]. More recently,

Latin America and the Caribbean's GDP for 2023 was reported at \$7.094 trillion, marking an 11.87% increase from 2022 [20].

A significant observation emerges when comparing Latin America's economic size to its maritime influence whereby despite accounting for 7.3% of global GDP and 8% of the world's population [19], the region's share in the global maritime transport industry is remarkably small, representing less than 2% of the total fleet by Deadweight Tonnage (DWT). This substantial gap indicates that Latin America predominantly relies on foreign-owned and operated fleets for its international trade. While the region mobilizes more than 17% of global maritime cargo, its minimal ownership of transport capacity implies a reduced degree of strategic control over its supply chains, increased vulnerability to external freight rate fluctuations, and a continuous outflow of freight payments to foreign carriers. This highlights a strategic vulnerability for the region but also presents a considerable opportunity for developing indigenous maritime transport capacity, which could enhance economic resilience, stimulate job creation, and retain value within the region [21].

Historically, Latin America's economy has been export-based, with agriculture and mining serving as its two primary economic sectors. The region is endowed with vast areas rich in minerals and raw materials, and its diverse tropical and temperate climates are highly conducive to growing a wide variety of agricultural products [22].

Latin America contributes significantly to global food production, accounting for 16% of the world's total food and agriculture output. Brazil and Argentina are notable net exporters of grains, oilseeds, and animal protein. South America alone produces 25% of the world's oranges and dominates global coffee production, with Brazil being the largest exporter [23]. In the mining sector, Chile and Peru are significant players, producing 40% of the global copper supply, while Chile and Argentina together supply 32% of the world's lithium [24]. Beyond primary commodities, the region also has a growing manufacturing base, with Brazil ranking among the top 10 steel producers and Mexico among the top 15 globally. Both Mexico and Brazil are also among the top 10 vehicle manufacturers worldwide [22].

This economic structure, heavily reliant on primary commodity exports, exposes the region to commodity price volatility and limits the proportion of value-added trade. However, it also signifies Latin America's critical role in supplying essential resources to the global economy. The global shift towards digital and climate transition, as noted in the research, implies a growing demand for critical minerals like copper and lithium [24]. This presents a significant opportunity for Latin America to leverage its resource wealth in these areas. Simultaneously, there is a recognized need for the region to diversify its economy away from an over-reliance on fossil fuels. This dual nature of the economy will influence the types of cargo transported, necessitating a mix of bulk and break-bulk carriers for raw materials, alongside growing demand for containerized services for manufactured goods and specialized vessels for high-value products.

Latin America's economic growth is propelled by several key drivers, including its abundant natural resources, a growing human capital base, and emerging technological innovation [25]. Despite currently ongoing political turbulences between US administration and their southern American neighbour countries, the region is still strategically well positioned to benefit from shifts in global trade patterns, particularly through "nearshoring" opportunities for U.S. manufacturing imports. Increasing economic interest from Europe, China and ASEAN countries compensate setbacks in US trade with Mexico and Central America seems still to be prime beneficiaries [24].

However, the region faces significant challenges that can impede its full economic potential. These include a deceleration in external aggregate demand, increased exchange-rate volatility, and the persistent need for fiscal progress to bring national debts to sustainable levels. The policies of new U.S. administrations also introduce an element of uncertainty [25]. Internally, poor infrastructure, burdensome customs clearance procedures, and relatively high tariff and non-tariff barriers to trade continue to hinder economic efficiency [26]. This situation illustrates that while global trade patterns, such as trade wars and nearshoring trends, create clear opportunities for Latin America to capture increased market share, the region's internal inefficiencies act as a significant bottleneck. Addressing these internal barriers through targeted infrastructure development, streamlining customs processes, and harmonizing regulations is as crucial as capitalizing on external market opportunities for boosting maritime trade volumes and overall economic competitiveness.

1.5. Challenges Facing Latin America Maritime

a. Infrastructure Bottlenecks and Congestion

- *Port infrastructure* in Latin America is under significant strain, with many major hubs operating at or above their designed capacity. This has resulted in widespread bottlenecks, extended vessel waiting times, and increased logistics costs, all of which erode the region's competitiveness in global trade. The following section outlines the core challenges driving these issues:
- *Capacity Limits*: Leading ports such as Santos, Manzanillo, and Cartagena are experiencing congestion as trade volumes outpace infrastructure growth. These ports frequently operate near or above their intended capacity, causing vessel delays and driving up operational costs for shippers and exporters [27]
- *Aging Infrastructure*: Much of the region's port equipment and hinterland connections such as roads and railways are outdated. This limits the ability to efficiently handle larger, modern vessels and exacerbates delays, especially during peak periods or when facing surges in cargo volumes [28].
- *Investment Gaps*: Although there is strong interest in upgrading port infrastructure, the scale and pace of investment often lag the rapid growth in demand. This is particularly acute in secondary ports, where underinvestment leads to inefficiencies and missed opportunities for capacity expansion [29].

b. Security and Crime

Security remains a critical concern for Latin American ports, significantly impacting operational efficiency and the region's attractiveness to global trade partners. Persistent threats from organized crime, coupled with regulatory and governance challenges, create a complex environment for port operators and stakeholders. Key security issues include:

- *Organized Crime:* Ports in countries such as Colombia, Mexico, and Brazil are particularly vulnerable to activities like drug trafficking, cargo theft, and smuggling. These risks not only endanger personnel and cargo but also drive-up insurance premiums and can deter much-needed foreign investment. [30, 31].
- *Corruption and Customs Delays:* Complicated regulatory frameworks and instances of corruption contribute to prolonged cargo clearance times. This not only increases dwell times and operational costs but also undermines the overall reliability and competitiveness of the region's ports [32].

c. Environmental and Climate Risks

Environmental and climate-related risks are emerging as major challenges for ports across Latin America, threatening both day-to-day operations and long-term sustainability. Ports must now contend with more frequent and severe weather events, the impacts of climate change on coastal infrastructure, and increasing pressure to reduce their environmental footprint. The main issues include:

- *Extreme Weather:* Ports are increasingly disrupted by hurricanes, floods, and droughts events that can halt operations and delay shipping schedules. The Panama Canal, for example, has faced significant disruptions due to prolonged droughts affecting water levels and transit capacity [27].
- *Sea Level Rise:* Rising sea levels and more intense storm surges are putting coastal port infrastructure at greater risk of damage. Adapting to these changes will require substantial investment in resilience measures and infrastructure upgrades to ensure continued operations [33].
- *Pollution and Decarbonization:* There is growing pressure on ports and shipping companies to reduce emissions and adopt greener practices. However, transitioning to cleaner technologies and retrofitting existing infrastructure and fleets is both costly and technologically demanding [30]

d. Regulatory and Policy Challenges

Regulatory and policy challenges present significant obstacles to the smooth functioning and integration of Latin American ports within the global supply chain. The region's complex and often fragmented regulatory landscape, coupled with political and policy uncertainties, can disrupt logistics operations and deter long-term investment. The main issues include:

- *Fragmented Regulations:* Differences in customs procedures, safety standards, and environmental regulations across Latin American countries hinder regional integration and complicate cross-border logistics. These regulatory inconsistencies force logistics providers to navigate a patchwork of requirements, slowing down cargo movement and increasing compliance costs [28].

- *Uncertain Policy Environment:* Political instability and frequent shifts in trade policies such as changes in tariffs or protectionist measures create an unpredictable investment climate. This uncertainty can delay or discourage the long-term investments needed to modernize port infrastructure and improve operational efficiency [33].

e. Shipbuilding and Fleet Modernization Constraints

Shipbuilding and fleet modernization are critical for supporting Latin America's maritime ambitions, but the region faces significant constraints in upgrading and expanding its fleet. These challenges limit the ability of local operators to respond to evolving market demands and technological trends. The main constraints include:

- *Limited Regional Shipbuilding Capacity:* Latin America remains heavily dependent on foreign-built ships, as local shipyards are relatively few, often small in scale, and face high capital and labour costs. Additionally, the high Asian capacity and its strong position on global shipbuilding market slows down the development of regional shipbuilding industry. This reliance on imports can delay fleet renewal and increase operational costs.
- *Volatile Costs:* The shipbuilding sector is highly sensitive to fluctuations in the prices of steel, labour, and advanced technologies. This volatility makes investment in new vessels risky and can deter both public and private sector investment in local shipyards [27].
- *Need for Specialized Vessels:* Emerging sectors such as deep-sea mining, aquafarming, and renewable energy are driving demand for specialized vessels such as ice-going ships, anti-flooding designs, and those powered by LNG or methanol. However, local shipyards may lack the technical expertise or production scale to efficiently build these advanced vessel types.

f. Technological Gaps

Technological advancement is transforming the global maritime industry, but many Latin American ports are struggling to keep pace. The slow adoption of digital tools and smart technologies, combined with new risks associated with digitalization, is creating a technological gap that affects efficiency, security, and competitiveness. Key challenges include:

- *Digitalization Lag:* Although some leading ports are beginning to implement automation, artificial intelligence, and blockchain solutions, a significant number still depend on manual processes. This reliance on outdated methods limits operational efficiency, reduces transparency, and hampers the ability to integrate with global supply chains [29].
- *Cybersecurity Risks:* As ports increasingly adopt digital technologies, they also become more vulnerable to cyberattacks. Cybersecurity threats can disrupt port operations, compromise sensitive data, and lead to significant financial and reputational losses [31].

g. Human Capital and Skills Shortage

A skilled and adaptable workforce is essential for the modernization and competitiveness of Latin America's port and maritime sectors. However, persistent workforce gaps and inadequate training programs are slowing progress and limiting the region's ability to leverage new technologies. The main workforce challenges include:

- *Workforce Gaps:* There is a notable shortage of skilled professionals in key areas such as logistics, engineering, and digital technologies. This talent gap makes it difficult to implement modernization initiatives and adopt advanced systems effectively [32].
- *Training Needs:* The rapid pace of technological change in the maritime industry demands continuous upskilling and reskilling of the workforce. Unfortunately, many existing training programs are insufficient, outdated, or not aligned with current industry needs, further exacerbating the skills shortage [28].

h. Financial and Investment Risks

Securing adequate financing is a fundamental challenge for the development and modernization of Latin America's ports and shipbuilding sector. The region's ambitious infrastructure projects demand significant capital and face persistent barriers to investment. Key financial and investment risks include:

- *High Capital Requirements:* Port and shipbuilding projects require massive upfront investments, often running into hundreds of millions or even billions of dollars, with long payback periods. For example, recent port modernization and expansion projects in Peru and Mexico involve investments ranging from US\$180 million to over US\$3 billion for single terminals or new port developments.
- *Access to Finance:* Smaller ports and shipyards, particularly in countries with less developed financial systems or higher perceived risks, often struggle to secure the necessary funding. This can limit their ability to modernize, expand, or adopt new technologies, putting them at a competitive disadvantage compared to larger, better-funded facilities [29].

South America's maritime sector is a cornerstone of its economic development and regional integration. The continent's maritime infrastructure comprising seaports, inland waterways, shipyards, and logistics corridors serves as the gateway for over 90% of its international trade. Yet, this infrastructure remains uneven, with advanced ports like Santos, Cartagena, and Callao coexisting alongside underdeveloped or inefficient facilities that limit broader connectivity and competitiveness.

The economic hotspots identified Brazil, Chile, Colombia, Peru, and Panama illustrate the diverse nature of maritime activities across the continent. Brazil dominates bulk shipping and offshore energy; Chile and Peru thrive on Pacific-bound agricultural and mineral exports; Colombia and Panama provide vital transshipment and logistics services bridging both oceans. These nations offer critical lessons in port modernization, public-private partnerships, and the strategic use of digital and green technologies.

To unlock the full potential of the region's maritime economy, governments and stakeholders must prioritize coordinated investment in port infrastructure, foster intermodal integration, embrace smart port solutions, and adapt to environmental challenges. Only through such a holistic approach can South America transform its maritime domain into a fully integrated, resilient, and future-ready economic engine.

2. Role and Scope of Maritime Infrastructure

The basis of international trade and domestic business activities in South America is the diverse maritime infrastructure along coastal, inland and offshore parts. Important deep-sea ports in this region, like Santos (Brazil), Callao (Peru) and Valparaíso (Chile), mainly manage all exports that are containerized or in large volumes. They work with coastal logistics centres, dry ports, terminals on major inland waterways (especially those on the Paraná-Paraguay Waterway) and intermodal systems that enable ships to access farming and industrial facilities far from the seaports [12].

As well as cargo terminals, South America's ports and shipping routes consist of facilities for repairing and building vessels (mainly available in Brazil and Argentina), dry docks, spaces for loading oil and gas, as well as critical services including piloting, towing, dredging and customs processing [9]. These services are necessary for handling port operations safely, effectively and in an environmentally friendly way across the world.

The area's maritime infrastructure provides benefits for both commercial and defence purposes. Brazil, Chile, Peru and Argentina depend on the international market to sell large quantities of soybeans, copper, lithium, crude oil and iron ore. On a local scale, ports and waterways make it possible to get goods, agricultural products and materials where road and rail connections are not as good [5].

2.1. Regional Economic Integration Blocs and their Maritime Impact

MERCOSUR: The Southern Common Market (MERCOSUR), comprising Argentina, Brazil, Paraguay, Uruguay, and Bolivia as full member and with Venezuela as currently suspended member, aims to foster a common economic space that generates business and investment opportunities. Covering a vast territory of almost 15 million km² and home to over 295 million people, MERCOSUR has established a Common External Tariff (CET) and strives for greater policy harmonization among its members [34]. The agreement also explicitly promotes the provision of cross-border services, including maritime transport [35] and in 2023, intra-MERCOSUR trade demonstrated resilience, growing by 4.2% despite an overall fall in the bloc's external sales [36].

The resilience and growth of intra-bloc trade within MERCOSUR suggest a significant potential to boost maritime transport within the Southern Hemisphere. Increased trade among MERCOSUR members would necessitate more robust and efficient short-sea shipping and cabotage services, potentially stimulating demand for smaller, regionally-focused vessels and specialized port infrastructure to handle this increased internal movement of goods.

Pacific Alliance: The Pacific Alliance (PA), consisting of Chile, Colombia, Mexico, and Peru, represents a significant economic force, accounting for over 35% of Latin America's GDP, 50% of its total trade, and attracting 45% of its foreign investment [37]. The PA has made concrete strides towards integration, including the elimination of tariffs on 92% of intra-Alliance trade and a focus on

harmonizing regulatory frameworks [38]. A key objective of the PA is to position its member states as a hub for international trade, particularly with the Asia-Pacific region. Intra-bloc trade within the Pacific Alliance demonstrated resilience and strengthened during the COVID-19 pandemic, highlighting the bloc's ability to cushion global trade shocks [39].

The Pacific Alliance's explicit focus on enhancing trade with the Asia-Pacific region directly aligns with global trade shifts towards Asia and the broader need for increased North-South and intra-Southern Hemisphere maritime transport. This strategic orientation indicates a strong potential for increased maritime trade volumes on East-West routes, necessitating investments in larger container vessels and bulk carriers, as well as significant upgrades and expansions in Pacific coast ports to accommodate increased throughput and larger ship sizes.

Andean Community: The Andean Community (CAN), historically comprising Bolivia, Colombia, Ecuador, Peru, and Venezuela, aimed to establish an intra-regional free trade area and a common external tariff [40]. A significant policy shift occurred which led to the liberalization of shipping activities among member states, urging them to review their national legislation accordingly [41].

This liberalization of shipping activities, if fully implemented and sustained, holds the potential to substantially reduce maritime transport costs within the Andean region, thereby making intra-regional trade more competitive. This could stimulate increased maritime movements among member countries. Furthermore, it signals a shift towards market-driven efficiency in maritime logistics, which could attract greater private investment in shipping services and infrastructure across the Andean region.

2.2. Trade Patterns: Exports and Imports

Latin America's economy is deeply tied to maritime transport due to its export-oriented structure and geographical features. The continent possesses vast natural resources, including minerals, energy, and agricultural products, most of which reach international markets via maritime routes. Ports serve as critical nodes for trade, while maritime logistics support regional integration and global competitiveness [42]

When it comes to its exports, the Latin America and the Caribbean's exports experienced a 4.1% growth in 2024, a positive turnaround after a 1.6% contraction in 2023, largely driven by an increase in export volumes [43]. The region's export profile remains dominated by primary commodities. In 2023, major exports by value included ores, slag, and ash (\$102 billion); oil seeds and oleaginous fruits (\$48.37 billion); edible fruit and nuts (\$28.71 billion); meat and edible meat offal (\$22.01 billion); copper and articles thereof (\$19.05 billion); fish and other aquatic invertebrates (\$17.50 billion); sugars and sugar confectionery (\$17.00 billion); and coffee, tea, and spices (\$14.94 billion) [42]. Crude oil was notably Brazil's top export in 2024, with China being its main buyer [44]. South America alone accounts for approximately 10% of global agricultural product exports [23].

While traditional commodities like oil and coal continue to be major exports, global climate objectives and the "Green Road" scenarios outlined in broader maritime discussions suggest a future shift towards bioenergy commodities (such as wood and cork) and critical minerals. Latin America possesses ample land for bioenergy production [46]. and significant reserves of critical minerals like copper and lithium [24]. This implies a future shift in the types of bulk carriers required for Latin American exports. While traditional bulkers for iron ore and coal will remain important in the near term, there will be an increasing demand for vessels capable of transporting biomass, wood products, and specialized mineral concentrates. This evolution in the export mix necessitates diversified port infrastructure to handle these changing cargo types efficiently.

On the import side, Latin America's regional imports grew by 3.2% in 2024, following a 6.8% contraction in 2023 [43]. Almost three-fourths of South America's imports consist of machinery, vehicles and parts, chemicals and pharmaceuticals, paper and paperboard, textile products, and other manufactured goods [47]. Manufactured goods accounted for 72% of merchandise imports for Latin America and the Caribbean in 2023 [48]. Furthermore, U.S. imports from Latin America and the Caribbean, particularly agri-food products, are projected to grow at a Compound Annual Growth Rate (CAGR) of 10.3% through 2025 [11].

This strong demand for manufactured goods and growing agri-food imports highlights the need for robust container shipping services and specialized reefer capacity for perishable food products. The high volume of manufactured imports also necessitates efficient port handling and extensive inland distribution networks to serve the region's expanding urban populations. The reliance on imports for industrial goods, as noted in the analysis, further emphasizes the importance of efficient supply chains for manufacturing inputs, underscoring the interconnectedness of port operations and internal logistics. Table 1. shows the summary of the Latin America & Caribbean Economic Indicators and Trade Profile.

Table 1. *Latin America & Caribbean Key Economic Indicators and Trade Profile. Source: Multiple sources*

Indicator	Value/Year	Source
Population	663 million (2024)	[6]
Population Projection	730 million (2053 peak)	[7]
Urbanization Rate	~80% (Current)	[12]
Median Age	31 years (2024), ~40 years (2050)	[6]
Literacy Rate	94.60% (2022)	[13]
GDP	\$7.094 trillion (2023)	[20]
Contribution to Global GDP	7.3% (2021)	[19]
GDP per Capita	\$18,560 (2021)	[19]
Major Export Commodities (2023)	Ores, slag, ash: \$102B; Oil seeds: \$48.37B; Edible fruit/nuts: \$28.71B; Meat: \$22.01B; Copper: \$19.05B; Fish: \$17.50B; Sugars: \$17.00B; Coffee, tea, spices: \$14.94B	[44, 45]
Major Import Categories (2023)	Manufactures: 72% of merchandise imports; Machinery, vehicles, chemicals, pharmaceuticals, paper, textiles; Agri-food imports to US from Latin America growing at 10.3% CAGR (through 2025)	[11]

2.3. Inland Waterways and Fluvial Transport Integration

Latin America is rich in rivers and wetlands, for instance, the Amazon, the Orinoco system and the Paraná Paraguay waterway which stretches across Brazil, Bolivia, Paraguay, Argentina and Uruguay shown in Figure 3. These rivers are inexpensive, environmentally safe and therefore needed for large-scale transportation and trade in countries that do not have access to the oceans such as Paraguay and certain areas in Bolivia [49].

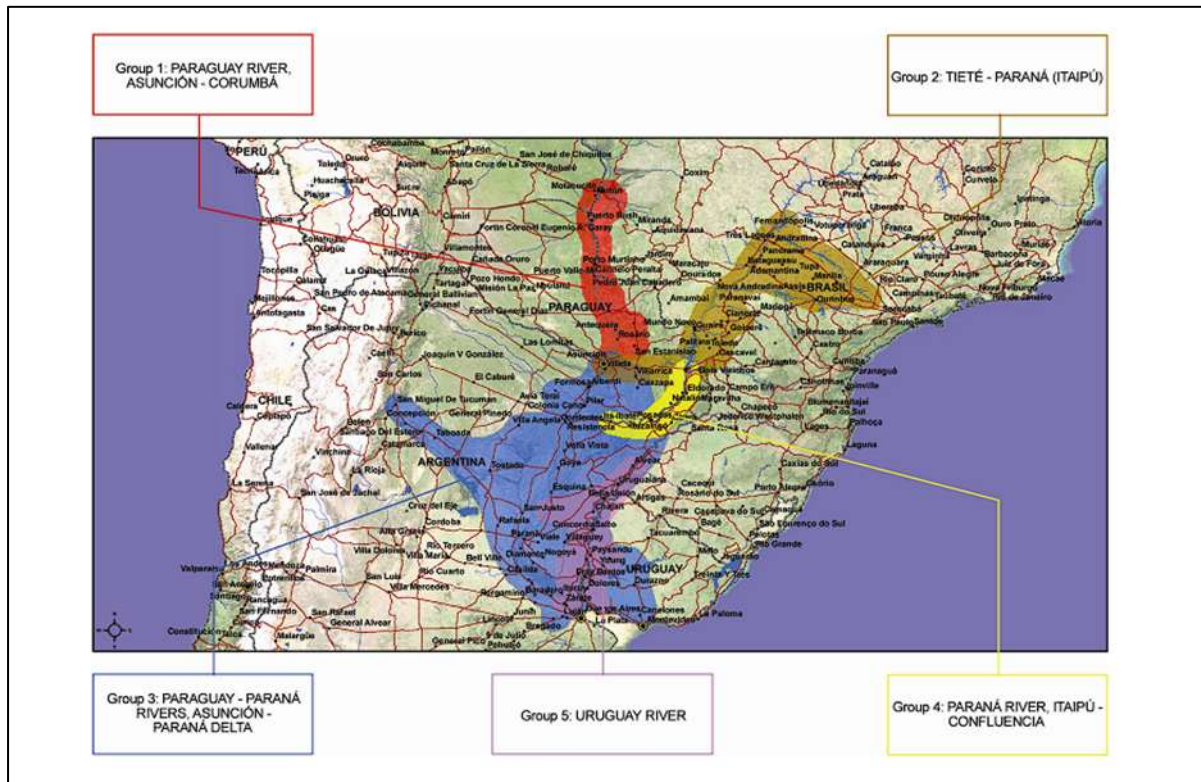


Figure 3. Paraguay - Parana Waterway / Source: IIRSA [50]

Using the inland waterways can potentially decrease costs and emissions and give a good alternative to using road or rail for long-distance freight which is a win for in terms of environmental protection [51]. However, inland water transport has not reached its full place in logistics operations because of several ongoing problems. The way dredging is carried out irregularly affects how easy it is to navigate the river in shallow areas and changes in water levels during the dry season also cut down on year-round transportation. Moreover, few river ports have up-to-date facilities for handling goods and joining the land and rail services which makes it hard to move products efficiently between modes. Also, because the nations along these waterways seldom cooperate closely, the governance is split and not much is done to improve the existing infrastructure [52].

Bringing inland water systems together with coastal and deep-sea ports is necessary for making a smooth and efficient logistics chain across South America. For this to happen, there should be matching regulations, common strategies for investing and coordinated administration of finances across

international borders. More efficient fluvial transport would help trade in the region and support economic growth by linking areas far from the coast with main export port regions [53].

2.4. Infrastructure Development and Regional Cooperation

In the past few years, some South American countries have begun improving their coastal facilities to make the region more connected and internationally trade competitive. There has been a significant rise in public-private partnerships to handle annual port expansion projects and their costs. Because of these agreements, countries like Brazil, Colombia and Peru have expanded and improved their ports thanks to the support of investors and advanced skills [54].

Building and connecting infrastructure across countries have improved the connectivity of regions. A major example is the BI oceanic Corridor which is designed to link the Atlantic and Pacific oceans by means of Brazil, Paraguay, Argentina and Chile. Figure 4 shows the connecting links along the Central - West integration zone of south America



Figure 4. Bi-Oceanic Corridor / Source: Hurtado [55]

It is generally thought that this route will make shipping and transportation to overseas buyers less expensive and faster for landlocked nations such as Paraguay and Bolivia. These types of projects help South America get past long-standing geographical obstacles and form a tighter trade community. The upgrades in infrastructure have been funded and supported by regional organizations like Union of South American Nations (UNASUR), Southern Common Market (MERCOSUR) and Inter-American Development Bank (IDB). This way, they secure coordination of sea development worldwide, so countries have standard procedures and long-term development plans.

Infrastructure that benefits the maritime sector must be sustainable and effective. Smooth customs processes help avoid long wait times and safe movement of goods between nations. It is also necessary to have common technological rules for activities like port operations, working with containers and intermodal systems for things to connect smoothly. Digital investments such as building port community systems (PCS), tracking and monitoring systems and ensuring cyber safety, play a big role in improving a port's efficiency and security. Also, planning ports across borders ought to be well-coordinated to ensure similar actions are avoided and objectives are consistent among countries [56].

2.5. Environmental and Sustainability Dimensions

South American ports are being urged to follow green logistics and cut down on their impact. The sea industry which is well-known for harming the environment and the climate, is now working toward adopting cleaner, tougher operations. In this situation, making ports more sustainable is very important for the region which involves electrifying cargo handling, giving vessels the chance to turn off their engines while docked and setting up systems to keep invasive species out of ballast water [57].

Proper waste handling and plans to prevent oil spills are just as important for the safety of marine life and following worldwide rules on the environment. Ports across South America are mostly in the beginning stages of changing into modern facilities. Concerns such as not enough money for new changes, loose enforcement of rules and old equipment have stopped some ports from bringing green technology on board [58]. In addition, without unified environmental rules among countries, it is challenging to carry out unified regional actions for the environment.

Even though there are significant problems, we can see improvements happening. Eco-friendly investments and following international guidelines for the environment have made Puerto de Cartagena in Colombia and Puerto San Antonio in Chile leaders in their regions. At Puerto de Cartagena, energy-saving lights, electric cranes and advanced waste handling are being used, while Puerto San Antonio introduced a plan to reduce emissions and started trying out cold ironing equipment [59].

One way to speed up greener ports in South America is to build strong frameworks, get funding from climate schemes and team up with their neighbours to innovate in the environmental sector. Making sure that stakeholders including port authorities, shipping lines, local groups and NGOs are involved will be important for including sustainability in maritime logistics and management [56].

2.6. Outlook on Maritime Strategy

The future of South America's maritime industry depends on using innovation, being inclusive and being sustainable. With supply chains being digitized and more attention geared towards climate cause, countries in South America must develop maritime policies to increase their competitiveness, guard their seas and safeguard the marine environment. It is necessary to transform port logistics into digital solutions. Smart technology is used at ports, blockchain is adopted for transparent and efficient customs

clearance and AI cranes assist with carrying out the job of loading and unloading cargo [60] to help ports and shipowners spend less on operations, handle cargo more efficiently and remain strong against problems in the supply chain.

Investment should also go into building integrated routes that links remote or disconnected production areas to the world marketplaces. Promoting such connections would make it possible for items to move by road, rail and river and help the whole region develop in an inclusive way. The integration between these regions is necessary to address the long-standing problem of economic divide caused by different country locations.

Improving resistance to climate change in the country's seaports and harbours is another important goal. Higher sea levels, stronger storms and coastal erosion threaten ports and steps such as uplifting buildings, reinforcing protective barriers and using advanced weather forecasting are now very important. Always, maritime governance must be improved to handle urgent security matters such as IUU fishing, trafficking at sea and border conflicts. To keep the blue economy safe, the continent needs efficient observation, coordination among navy forces and steady commitment to international maritime laws [61].

Building maritime infrastructure that is resilient, smart and sustainable will allow South America to fulfil future trade activities and care for nature and its interests. This way, the continent will be able to take a bigger part in international shipping and protect its great marine and coastline resources for future generations [56].

3. The Caribbean - Caribbean Community (CARICOM)

As part of its assistance program for the Caribbean, the Economic Commission for Latin America and the Caribbean (ECLAC), through its Subregional Headquarters for the Caribbean, has produced economic profiles covering 26 countries and territories in the region [62]. The currently market analysis focuses specifically on the Caribbean Community (CARICOM), which comprises 15 full member states including Antigua and Barbuda, The Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Haiti, Jamaica, Montserrat, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, and Trinidad and Tobago as well as additionally 5 associate members, including Anguilla, Bermuda, the British Virgin Islands, the Cayman Islands, and the Turks and Caicos Islands [63].

Approximately 84% of the world's traded cargo volume and nearly 70% of its trade value are made possible by maritime logistics, which is essential to international trade. Similar patterns can be seen in Latin America, especially in the South American subregion, where more than 80% of trade is handled by maritime transport. When looking at merchant fleets worldwide by flag of registration (measured in thousands of deadweight tons, or DWT), Panama comes in first place with 16.1% of the global fleet in 2021, according to UNCTADSTAT (2022) [64]. The list also includes several flag-of-convenience registries, with the Bahamas, a CARICOM member, ranking eighth and contributing 3.5% of global DWT. While flags of registration do not necessarily reflect the physical presence or ownership of maritime companies within these countries, the Latin American and Caribbean region collectively represented 21.5% of the global fleet by flag in 2021. Nonetheless, despite this significant share in registration, the region's actual involvement in the maritime transport industry remains relatively modest, particularly due to the decline or disappearance of national shipping lines over the past few decades.

Historically, the Caribbean has relied heavily on inter-island maritime transport, given its archipelagic geography. As early as 1958, with the creation of the West Indies Federation, regional leaders acknowledged the need for maritime connectivity to support economic integration and development. This recognition led to the launch of the West Indies Shipping Company (WISCo.) in 1963, a government-backed initiative that provided regular maritime services among the islands. WISCo. operated two vessels that served each island twice per month, enabling trade not only within the region but also with the United States. However, despite its strategic importance and trade-enhancing role, the company was not financially viable and relied heavily on government subsidies. Eventually, due to fiscal constraints and structural inefficiencies, the service was terminated in 1992 after nearly three decades of operation [65].

In recent years, the expansion of the Panama Canal has emerged as a potential game-changer for the Caribbean shipping sector. The canal's widening has allowed for the transit of larger vessels, triggering a shift in global shipping patterns and positioning the Caribbean to benefit from increased transshipment

activity. However, this shift also introduces new challenges, particularly for smaller ports that may lack the infrastructure to accommodate larger ships. As global shipping consolidates around hub-and-spoke networks, only a few main Caribbean ports are likely to become primary transshipment hubs, potentially marginalizing smaller ports. In this context, local feeder services provided by small-scale operators remain essential for maintaining maritime connectivity among the islands. Strengthening the feeder network not only supports the viability of secondary and tertiary ports, but also opens up avenues for formalizing and integrating informal shipping services into the regional maritime ecosystem [65].

Several CARICOM countries, most notably Jamaica and The Bahamas, are strategically positioned along key East-West global trade routes that intersect through the Panama Canal, as well as along North-South shipping corridors linking North and South America. Their geographic advantage, combined with their integration into the hub-and-spoke model of global container shipping, has enabled select ports to evolve into regional logistics hubs. However, other CARICOM ports have lagged behind, constrained by limited hinterlands and sluggish infrastructure reforms, which inhibit their ability to attract investment or increase competitiveness.

The transshipment market, while offering significant potential, is not without risk. It is highly susceptible to the volatile and cost-driven behavior of global shipping lines, which can easily relocate operations to minimize expenses. CARICOM transshipment ports have adopted different strategies to cope with this volatility. For example, Freeport (Bahamas) leverages its proximity to the U.S. and the restrictive Jones Act, which limits U.S. domestic maritime trade, to attract transshipment activity.

Freight rate dynamics across the Caribbean are influenced by several factors, including port connectivity, service frequency, infrastructure quality, and distance between trade nodes. Understanding these dynamics is crucial for policymakers and investors seeking to optimize regional shipping costs and improve service reliability. Additionally, while CARICOM countries form part of one of the world's most attractive cruise ship destinations, the oligopolistic nature of the cruise industry grants large operators substantial bargaining power that undermines the negotiating position of small island economies. Meanwhile, the rapid expansion of yachting and recreational boating introduces both challenges and new opportunities, especially in relation to marina infrastructure, tourism diversification, and marine conservation [66].

3.1. Key Market Segments

The maritime sector in Caribbean countries is multifaceted, with several distinct market segments that drive the region's economy. The most prominent are freight shipping or freight transportation, cruise tourism, yachting, port operations, and auxiliary maritime services [67]. Cargo shipping, both for imports and exports, forms the backbone of the region's trade, given the high dependency on maritime transport for economic survival [68]. Cruise shipping is another vital segment, as the Caribbean is the

leading global destination for cruise tourism, drawing millions of visitors annually and supporting extensive hospitality and service industries [69].

Yachting, while smaller in scale, is a lucrative niche, especially in high-end tourism markets, and supports a range of auxiliary services such as shipyards, chandlery, and bunkering. Port operations, including specialized terminals for commodities like sugar, bauxite, and petroleum, as well as general cargo and containerized goods, are critical facilitators of trade and tourism. The sector also includes informal shipping, particularly inter-island services, which are crucial for regional connectivity and the movement of goods among smaller islands [66].

CARIOM countries, such as Antigua and Barbuda, Jamaica, St Kitts and Nevis, St Lucia, St Vincent, and Trinidad and Tobago, have a few commitments mostly related to blue water services (international shipping services or freight transport). St Lucia and St Vincent and the Grenadines made commitments in maritime auxiliary services. Antigua and Barbuda and Trinidad and Tobago, and Jamaica made commitments in port sector services to a lesser extent [67]. Hence, these markets will be analysed in this market analysis.

3.2. Trade Development

CARICOM is deeply dependent on maritime transport, with ports serving as the essential hubs of trade across its island-based geography and the United States remained CARICOM's largest trading partner. The reliance on maritime trade is strongly tied to the region's geography, as a group of island nations, ports and shipping services are essential for economic activity. By both volume and value, maritime transport stands out as the most critical mode of freight movement. Maritime transport supports economic growth in several key ways [66]. The Reuters reported in July 28, 2025 in "Caribbean seeks stronger trade with Africa as traditional routes waver" that the United States was CARICOM's largest trading partner in 2023 and that they account for approximately 25% of exports and 39% of imports.

- a. Imported manufactured goods play a central role in meeting local consumption and supporting the tourism sector. While internal consumer demand has been growing slowly, tourism has driven a notable increase in demand for imported products such as construction materials, food, and manufactured items. Understanding how tourism fuels import needs is crucial, as it influences the overall structure of imports.
- b. Major imports include cement, household products, groceries, and drinking water. Apart from Trinidad and Tobago, all CARICOM countries rely on imports for petroleum products, which are critical for generating electricity.
- c. The relative share of primary product exports has slowly declined in recent years.
- d. CARICOM has seen moderate growth in the export of low- and medium-tech manufactured goods, with some countries also expanding into high-tech areas, especially in the IT sector.

- e. There is still a limited understanding of how intra-regional trade can complement national economies, which limits the potential for regional integration.
- f. Trinidad and Tobago and Jamaica have made progress in developing their manufacturing sectors, and are increasingly able to supply the region with locally made products.
- g. Other CARICOM nations are gradually moving away from dependence on single-crop agriculture, though the potential for agricultural diversification and industrial development remains largely untapped. Realizing this potential will require stronger marketing and branding, such as positioning Grenada as the “Spice Isle.”
- h. Intra-regional trade in energy commodities is dominated by Trinidad and Tobago, which is the region’s leading energy producer. However, the focus on energy has meant that investment in maritime infrastructure and port development has lagged behind. Only recently has the country begun working on a national maritime policy and started discussions on establishing a formal port authority.

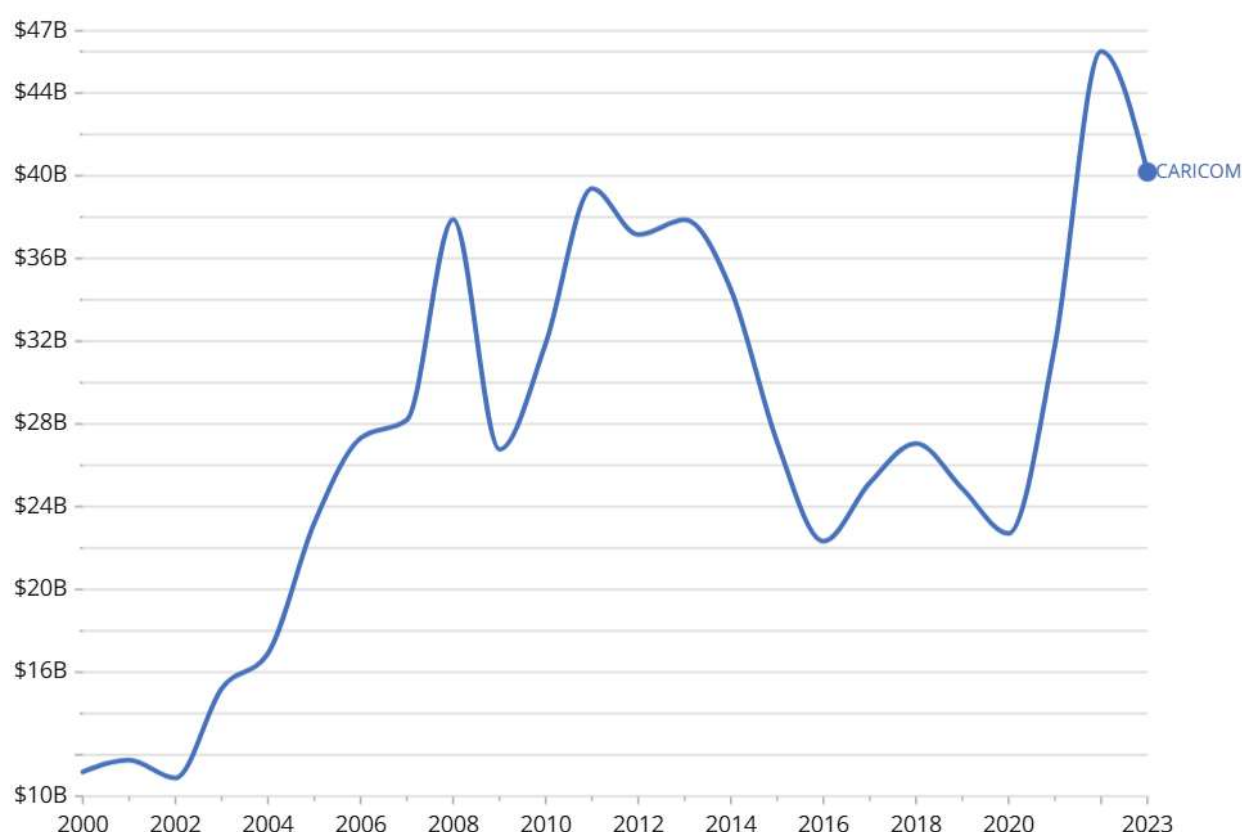


Figure 6. Annual Evolution of Total Exports of CARICOM Countries / Source: *OECD Today* [70].

Looking at Figure 6, in 2023, the Caribbean Community (CARICOM) recorded total exports of approximately \$40.2 billion, representing a 12.7% decline compared to 2022, when exports reached \$46 billion. Despite this recent downturn, CARICOM’s export performance over the past decade has shown a modest annual growth rate of 0.6%. The region’s top export commodities in 2023 were crude petroleum (\$15.1 billion), petroleum gas (\$3.93 billion), and gold (\$2.75 billion), highlighting

CARICOM's continued reliance on natural resources and extractive industries. In terms of export destinations, the United States remained the region's largest trading partner, accounting for \$9.76 billion of exports. Other major export markets included the Netherlands (\$2.5 billion) and Trinidad and Tobago (\$2 billion), underscoring both global and intra-regional trade linkages [70].

3.3. Maritime Freight Transportation

The maritime transportation industry has long been shaped by a complex history that includes piracy, slavery, and colonial exploitation, and for much of its existence, it primarily served small and localized markets. However, major developments such as rising global oil prices, the expansion of globalization, and the advent of containerization have dramatically reshaped the global shipping landscape. Unfortunately, the Caribbean region has struggled to adapt to these rapid changes as seen in the "Index of Vessel and TEU Deployment in the Caribbean Basin (Figure 7).

Maritime freight transport can generally be divided into bulk cargo and containerized cargo. Bulk cargo, which includes commodities like bauxite, petroleum products, sugar, ores, and cement, is typically shipped through non-regular, specialized services. These goods are often traded within well-established, consolidated markets and are part of vertically integrated production chains. In contrast, containerized exports from CARICOM countries make up only a small share of total export volumes [66]. However, extra-regional imports, primarily manufactured and consumer goods, are mostly containerized due to the nature of the products. In practical terms, the overall maritime transport volume to and from CARICOM nations is not high enough to support a large number of regular liner shipping services. This creates a major challenge in attracting consistent and cost-effective maritime connections.

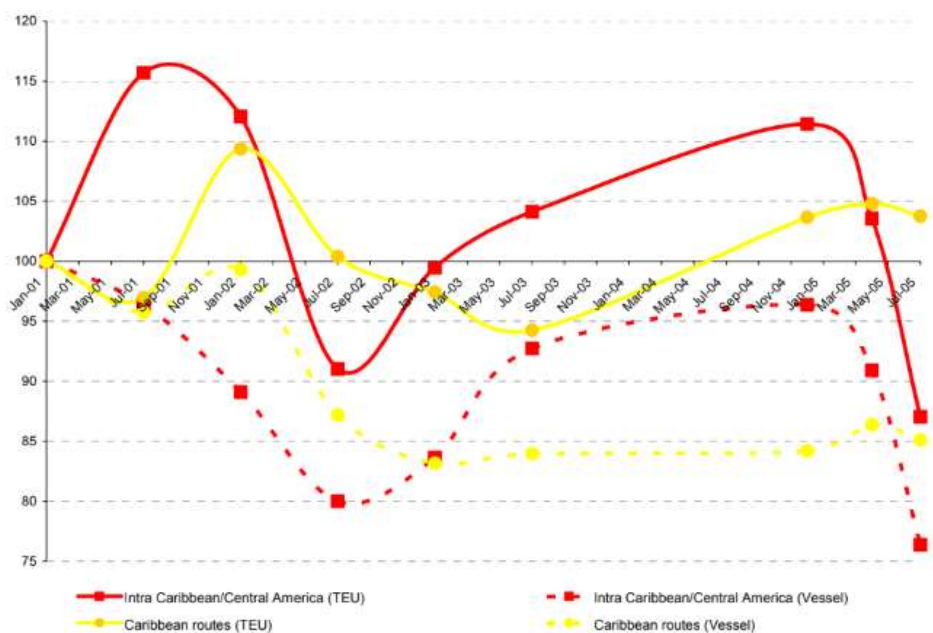


Figure 7. Index of Vessel and TEU Deployment in the Caribbean Basin / Source: Sanchez & Wilmsmeier, [66].

The Caribbean holds a strategic position within the global maritime network, lying at the crossroads between the Panama Canal and The Bahamas. This geographic advantage makes the region a key player in transshipment services and international shipping routes. Currently, the Latin American and Caribbean (LAC) region is responsible for handling approximately 17% of global maritime trade and 6.5% of total global container port traffic [71].

The role of CARICOM countries in the global container shipping network is shaped by two contrasting realities. On one hand, their location along major global shipping routes offers them a strategic advantage. On the other hand, most of the islands are geographically isolated and lack sizable hinterlands, limiting their ability to support large-scale logistics operations. This imbalance, combined with the ongoing restructuring of global container shipping into hierarchical “hub-and-spoke” systems, presents serious challenges, particularly for smaller islands with less-developed port infrastructure.

Despite these limitations, the Caribbean’s strategic position at the intersection of key north-south and east-west shipping lanes enables it to benefit from spillover traffic from global shipping routes. However, realizing the full potential of this advantage requires deliberate investment in port infrastructure, connectivity, and integration into regional and global supply chains.

Now, in the tenth generation of the container revolution, with vessels capable of carrying 25,000 twenty-foot equivalent units (TEUs) being ordered, Caribbean countries are under constant pressure to dredge shipping channels and modernize port infrastructure in order to stay competitive. But the challenges extend beyond physical upgrades. There is also a pressing need to recruit and retain skilled maritime professionals, which remains a significant issue across the region. At the same time, many Caribbean ports have fallen behind in adopting advanced information technologies, and there is considerable variation in productivity and development levels between countries and individual ports [64].

The rise of modern logistics models, such as globalization, just-in-time (JIT) delivery systems, and outsourcing, has created a demand for complex and highly efficient international supply chains. These systems are designed to ensure that goods arrive at the right place, at the right time, and at the right cost, whether on a manufacturing floor or in retail stores around the world. To meet this demand, global logistics service providers have emerged over the past few decades, forming strategic partnerships with manufacturers, distributors, and transport companies to streamline operations [67].

In 2021, Caribbean nations experienced uneven performance in the export of transport services. Several countries faced significant declines, including Grenada (-10.2%) and Trinidad and Tobago (-7.0%). These negative trends were largely driven by a combination of factors such as the global economic slowdown, volatile commodity prices, ongoing supply chain disruptions, and an overreliance on a limited number of trade partners [72]. However, maritime trade in Latin America and the Caribbean (LAC), including both goods loaded and discharged, amounted to 2 billion tons, a 3% increase over 2020. The continent accounted for 12.6% of total goods loaded and 5.8% of total goods discharged [73].

When evaluating logistics performance through the Logistics Performance Index (LPI), a measure developed by the World Bank, only a few Caribbean countries scored above the regional average for Latin America and the Caribbean (LAC) (Table 2). The LPI assesses a country's logistics capabilities based on key dimensions: efficiency of customs clearance, quality of trade and transport infrastructure, ease of arranging competitively priced shipments, competence of logistics services, ability to track and trace consignments, and timeliness of deliveries. The index is scored from 1 to 5, with higher scores indicating stronger logistics performance.

Table 2. *Caribbean Logistics Performance Index 2023. Source: World Bank [74].*

Country	LPI rank	LPI score	Customs score	Infrastructure score	International shipments score	Logistics competence score	Tracking & tracing score	Timeliness score
Antigua and Barbuda	66	2.9	2.2	2.7	2.9	2.9	3.2	3.4
The Bahamas	79	2.7	2.7	2.5	3.1	2.5	2.6	3.0
Dominican Republic	88	2.6	2.6	2.7	2.4	2.6	2.4	3.1
Grenada	97	2.5	2.6	2.5	2.6	2.2	2.3	3.1
Guyana	115	2.4	2.3	2.4	2.1	2.6	2.2	2.6
Jamaica	97	2.5	2.2	2.4	2.4	2.5	2.8	2.9
Trinidad and Tobago	97	2.5	2.2	2.4	2.5	2.4	2.5	2.9

Among CARICOM countries observed, Antigua and Barbuda achieved the highest overall LPI score, with 2.9 out of 5, ranking 66th out of 115 economies. This led in nearly all sub-categories, except for customs clearance and international shipment arrangements, where The Bahamas performed best. On the other end of the spectrum, Guyana ranked the lowest globally, with a score of 2.4, placing it 115th out of 115 economies, indicating significant challenges in its logistics system [74].

In today's shipping industry, economies of scale and technological innovation are the primary drivers of growth and competitiveness. However, the Caribbean, composed of numerous small, geographically dispersed island nations, faces unique challenges in aligning with these global trends. Its fragmented nature makes it difficult to participate effectively in the integrated, high-speed logistics networks that define modern trade. Nevertheless, globalization and the expansion of global supply chains depend heavily on efficient and interconnected transport networks, making it essential for the Caribbean to enhance its infrastructure, human resources, and technological capabilities in order to remain relevant.

3.4. Port Sector

The development of port infrastructure in the Caribbean has been deeply shaped by historical and global changes over the past two centuries. Originally, ports were constructed to serve colonial powers, shaped by the legacies of colonialism, piracy, and the transatlantic slave trade. As the global maritime industry underwent significant transformation, especially with the rise of containerization and the effects of globalization, Caribbean ports faced new pressures. In parallel, the region emerged as a dominant player

in the global cruise tourism market. This dual demand has created growing competition between cargo and cruise vessels for limited berthing space at ports.

In the UNCTAD (2022) report (Figure 8), despite the increasing complexity of global shipping, the Caribbean's response to maritime sector development has been fragmented, largely due to its composition of numerous microstates with limited coordination. As a result, many Caribbean ports have failed to modernize in step with global industry standards and now require comprehensive upgrades to remain viable and competitive.

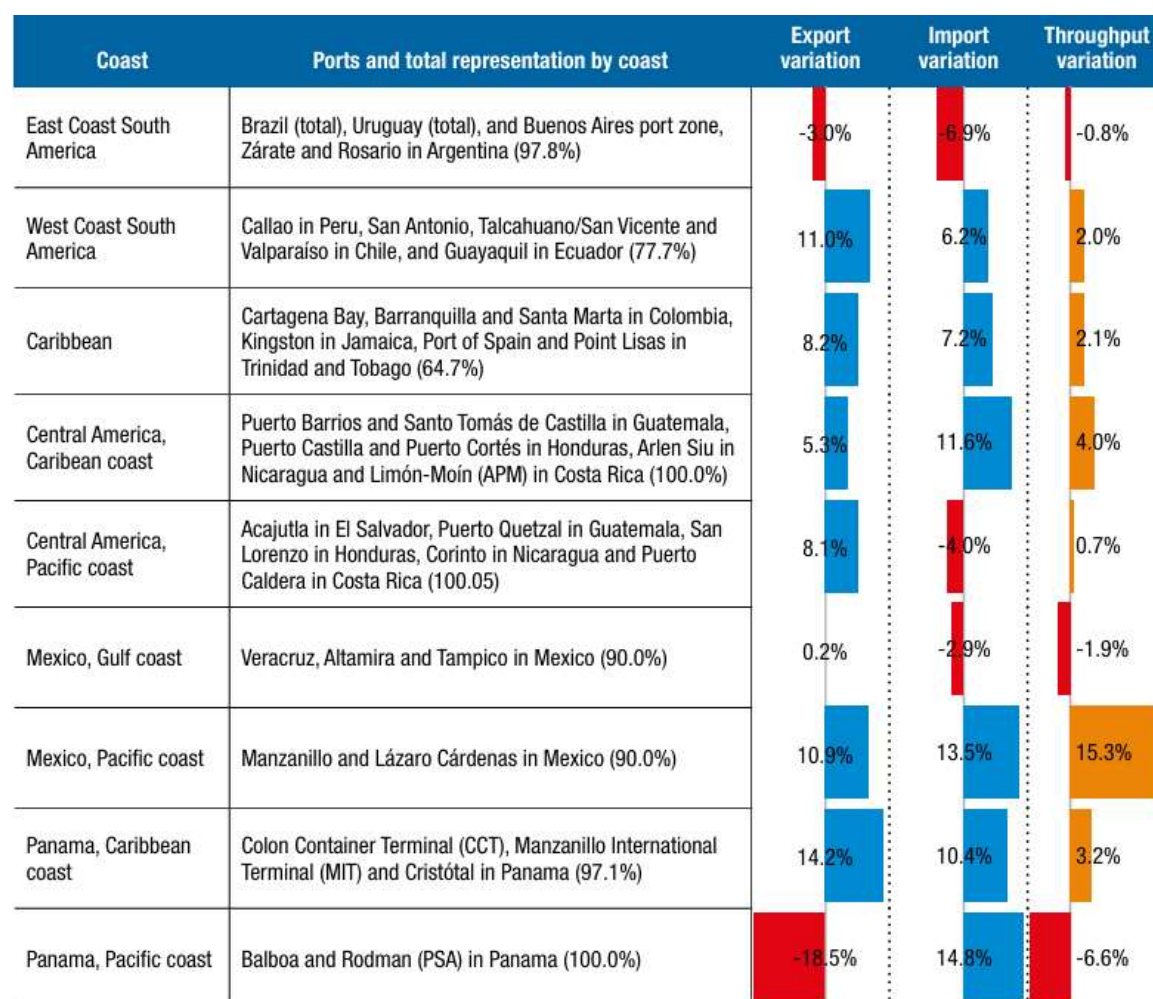


Figure 8. Trends in containerized trade and container port throughput January–June 2022 year-on-year variation / Source: UNCTAD [75].

Within the CARICOM framework, port infrastructure serves a dual function: it facilitates the movement of goods and acts as a critical intermediary in the regional and international transport chain. Ports across CARICOM fall into several categories [66].

- Specialized terminals: These are dedicated to specific export commodities, such as sugar (e.g., Georgetown, Guyana), bauxite (e.g., in Jamaica and Guyana), and petroleum (notably in Trinidad and Tobago).

- General-purpose public ports: These handle a mix of containerized and general cargo, serving broader national needs.
- Transshipment ports: These serve varying functions and scales:
 - Global transshipment hubs, such as Kingston (Jamaica) and Freeport (The Bahamas), serve as major links in international shipping routes.
 - Regional transshipment centres, like Bridgetown (Barbados) and Port of Spain (Trinidad and Tobago), facilitate Caribbean trade flows.
 - Inter-island transshipment ports, such as those in Castries (St. Lucia) and Bridgetown, connect smaller markets and enhance intra-regional shipping.

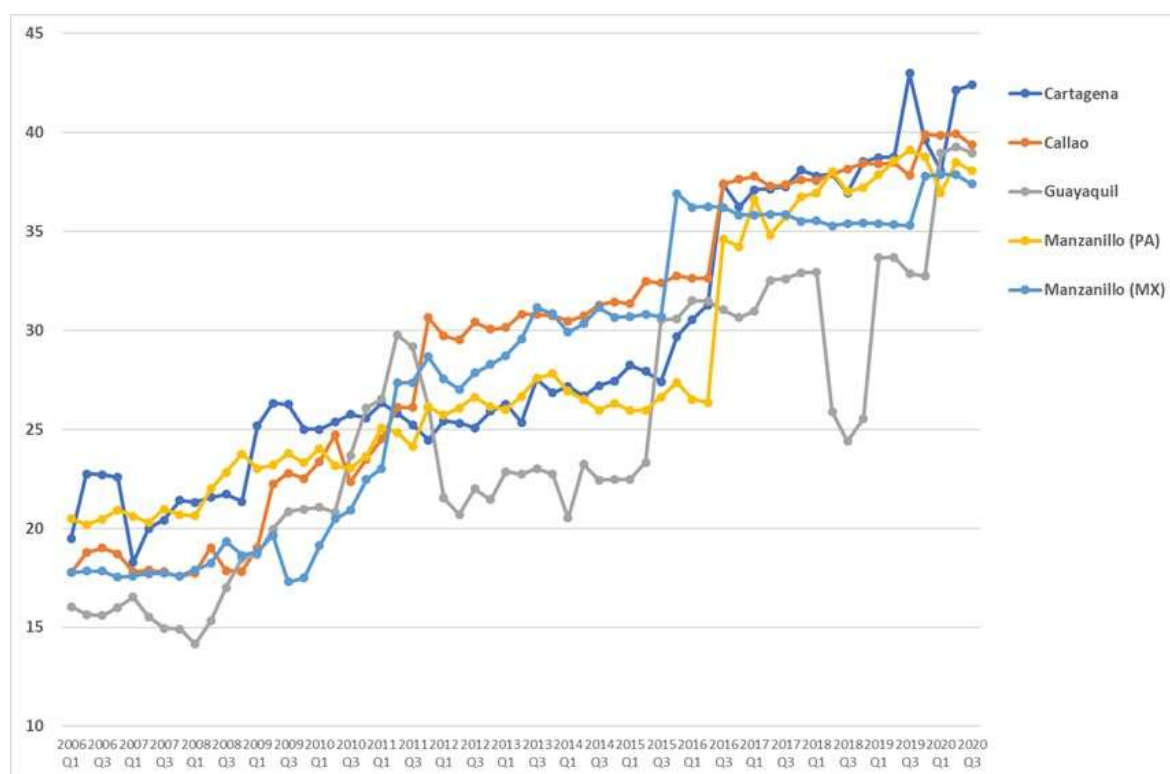


Figure 9. The top 5 ports in Latin America and the Caribbean, first quarter 2006 to third quarter 2020 / Source: UNCTAD [76].

Aside from these major terminals, approximately 20 other public ports operate across the islands, mainly catering to their domestic hinterlands. Additionally, numerous small wharves located along island coastlines support local and small-scale trade, reinforcing the diverse and decentralized nature of maritime infrastructure in the region [66].

Although overall GDP growth across the LAC region has been relatively modest, several Caribbean ports have experienced notable development in recent years, particularly following the expansion of the Panama Canal. Noteworthy examples include the ports of Kingston (Jamaica), Freeport (Bahamas), and Caucedo (Dominican Republic), which in 2022 were ranked the 4th, 5th, and 6th busiest ports in the Caribbean by tonnage, trailing only Panama and Cartagena shown in Figure 9.

Ports in the Caribbean are often seen as inefficient and behind global advancements, especially compared to regions that have embraced trends like digitalization and smart port technologies. Much of the maritime infrastructure in the Caribbean dates back to the 1960s, and despite the region's rich economic potential and opportunities for growth, it is still recovering from the impacts of the COVID-19 pandemic and frequent natural disasters, which have further delayed modernization efforts [77].

There is a pressing need to improve port management and operational performance if Caribbean nations want to remain competitive and relevant in the global maritime industry. When compared internationally (Figure 10), the quality of the region's infrastructure is often considered weaker than the average in Sub-Saharan Africa. A closer look at infrastructure indices shows that Caribbean ports are roughly on par with African ports in quality but outperform those in the Pacific. Given tourism's critical role in the Caribbean economy, higher port standards were expected. However, only Barbados scores above the regional average in port quality, followed by Jamaica and Suriname.

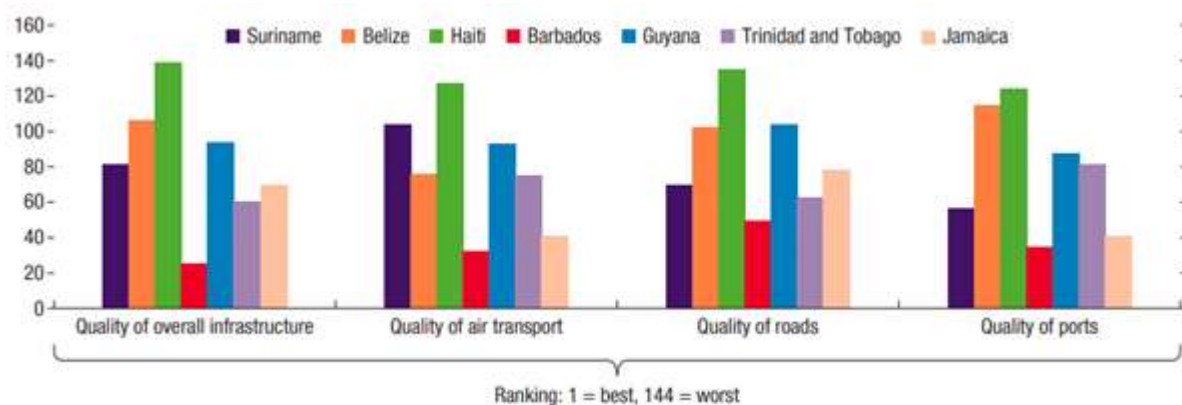


Figure 10. Infrastructure Quality in select Caribbean countries / Source: Baker et al. [71].

One of the biggest challenges to upgrading port infrastructure in the Caribbean is financial constraints. According to the latest UNDP report, Caribbean ports have suffered from a lack of maintenance and modernization, resulting in outdated facilities, inefficient operations, and high transit costs [71]. The Caribbean Small Island Developing States (SIDS) have faced longstanding difficulties in developing a reliable maritime transport system for moving goods to and from the islands. These problems are partly due to uncoordinated policies and an overly uniform approach to trade that doesn't reflect the diverse needs of the region. Currently, the infrastructure, which handles over 90% of the region's goods, is vulnerable to disruptions and inefficiencies.

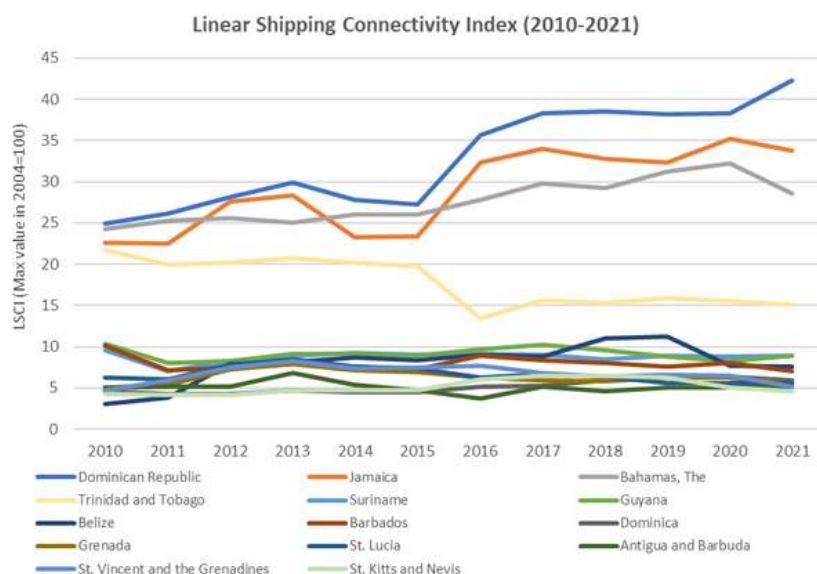


Figure 11. Linear Shipping Connectivity Index 2010-2021 / Source: Baker et al. [71].

Barker et al. [71]. show that most Caribbean SIDS rank lowest globally on the Liner Shipping Connectivity Index (LSCI) (Figure 11), with exceptions such as the Dominican Republic, the Bahamas, Jamaica, and Trinidad & Tobago. The LSCI measures how well a country's ports are connected to global shipping networks based on factors like the number of regular shipping routes, their reach, and vessel sizes. Caribbean connectivity has been a persistent issue because global shipping companies view the region as costly to serve due to small economies of scale and its distance from major shipping routes.

3.5. Cruise Shipping, Yachting and Auxiliary Services

Beyond cargo shipping, many Caribbean nations also serve as major hubs for the cruise industry. In 2022 alone, the region welcomed 18 million cruise passengers, accounting for 35% of all cruise travellers worldwide. Furthermore, the Caribbean continues to thrive as a luxury yachting destination, attracting high-end maritime tourism and reinforcing its significance in the broader maritime economy [77].

Cruise terminals and services supporting cruise tourism, such as waste management, parts supply, maintenance, and repairs, play a vital role in the region's maritime value chain. While most cruise ships visiting CARIFORUM ports are American, German companies like TUI and Aida (a subsidiary of Italy's Costa Cruises) also operate in the Caribbean.

The Caribbean is a popular year-round sailing destination, with over 700 islands to explore. Yacht prices range widely, from around USD 15,000 per week for standard all-inclusive yachts to over USD 1 million for luxury superyachts. This diversity creates significant opportunities in yacht and marina equipment, maintenance, crew services, as well as food and beverage supplies. Countries like the Bahamas boast extensive marinas that regularly accommodate many superyachts. Additionally, companies like Sunsail

and Moorings maintain large fleets of sailing yachts in the Caribbean that can be chartered with or without crews.

Trinidad and Tobago serve as a safe harbor during hurricane season and a hub for yacht maintenance and repair. The port of Chaguaramas in Trinidad offers berthing space for over 1,000 yachts, according to the Yacht Services Association of Trinidad & Tobago. Conveniently, direct flights from Amsterdam to Port of Spain facilitate travel and the shipment of parts.

According to the Inter-American Development Bank (IDB), the cruise tourism and yachting sectors in the Caribbean are well-developed. To further stimulate growth in yachting, Trinidad and Tobago has specifically opened its marina sector through Economic Partnership Agreement (EPA) negotiations. Under Trinidad and Tobago's EPA commitments, EU citizens and firms can establish businesses in this sector without needing a local partner. Stakeholders report a clear demand for marina development in Trinidad [79].

The cruise ship industry is highly concentrated, with three major companies, Carnival, Royal Caribbean, and Star Cruises, dominating the market. These companies have established the Florida Caribbean Cruise Association (FCCA) to advocate for the cruise industry's interests in the Caribbean. However, there is no dedicated cruise industry association specifically representing CARICOM countries. The FCCA actively promotes the cruise lines' priorities related to legislation, tourism development, taxation, and port safety and security. It also participates in regional port development efforts. Despite this, no specific FCCA-led port development projects were identified within CARICOM as of 2006. Meanwhile, FCCA member lines continuously search for new ports of call that offer suitable infrastructure and diverse attractions. These member lines provide the majority of passenger capacity to CARICOM, currently operating over 100 ships throughout the Caribbean [66].

3.6. Future Prospects of the Caribbean Maritime Sector

Looking ahead, the Caribbean maritime sector faces both significant opportunities and notable challenges that will shape its trajectory over the coming years. One of the most promising prospects is the region's strategic location at the crossroads of major global shipping routes, especially with the expanded Panama Canal now accommodating much larger vessels. This gives select Caribbean ports, like those in Jamaica and The Bahamas, a real chance to become leading transshipment and logistics hubs for international trade, provided they continue to invest in modern infrastructure and efficient operations [80].

Another positive development is the ongoing growth of cruise tourism and yachting, which are already major contributors to the region's economy. The Caribbean remains the world's top cruise destination, and as global demand for cruise vacations and luxury yachting increases, countries that invest in modern marinas, port facilities, and sustainable tourism practices stand to benefit the most. These sectors also

create opportunities for local businesses and foster job creation in hospitality, maintenance, and marine services [81].

However, the future is not without risks. The rise of mega-ships and the consolidation of global shipping lines mean that only a handful of Caribbean ports will likely attract the lion's share of transshipment business. Smaller ports may be left behind unless they can carve out specialized roles or strengthen their feeder services to connect with larger hubs. There is also the ongoing challenge of upgrading port infrastructure, adopting new technologies, and training a skilled maritime workforce, all of which require significant investment and long-term planning [78].

Sustainability and environmental resilience are becoming increasingly important for the sector's future. The Caribbean is highly vulnerable to climate change and extreme weather events, so investments in climate-resilient infrastructure, green port initiatives, and marine conservation are essential. Embracing the "blue economy" approach, balancing economic growth with ocean health, can help the region attract international funding and position itself as a leader in sustainable maritime development [82]

Finally, regional cooperation will be key to unlocking the sector's full potential. By harmonizing regulations, improving inter-island connectivity, and integrating informal shipping services into the formal economy, Caribbean countries can boost intra-regional trade and strengthen their collective bargaining power in global markets. While the path forward is complex, the Caribbean maritime sector has a real opportunity to modernize, diversify, and become more resilient in the years ahead

Opportunities abound in the maritime services, ports, and logistics sectors in Caribbean countries offer a wide range of promising business opportunities and key areas include [78, 80, 81]:

- a. **Port Infrastructure:** There is significant potential for upgrading existing ports and securing concessions to operate container terminals across various Caribbean ports. Notable growth prospects exist in ports such as Georgetown (Guyana) and Barbados, which is working toward becoming a green maritime hub. Additional opportunities involve providing dredging services to deepen channels, building breakwaters to improve climate resilience, and investing in dry-docking facilities.
- b. **Maritime Connectivity:** Enhancing maritime connectivity is crucial for regional integration, economic growth, and food security. There is growing demand for expanded freight capacity to support the region's development. Increasing vessel capacity on key routes, such as between Guyana and Trinidad and Tobago presents viable business prospects. Developing ferry terminals and affordable inter-island transport services are also important for improving goods movement. Other related opportunities include establishing water supply stations for vessels and cold storage facilities.

- c. **Cruise Tourism and Yachting:** With over 18 million cruise visitors in 2022, the Caribbean remains a major destination for cruise tourism and yachting. Investment opportunities exist in cruise terminals, related services, and marina development. Countries like the Bahamas host marinas catering to superyachts, while companies operate fleets of sailing yachts available for charter. Trinidad and Tobago, located south of the hurricane zone, serves as a safe haven and maintenance hub for yachts, creating potential for dry-docking investments to support this market.
- d. **Technology:** Introducing new technologies in the maritime and port industries can significantly improve efficiency and competitiveness. Innovations such as paperless maritime single windows, Port Community Systems, and advanced smart port technologies offer great potential to modernize Caribbean countries' ports.
- e. **Coastal Protection and Restoration:** The Caribbean's vulnerability to climate change and natural disasters highlights the need for projects focused on coastal protection and restoration. Expertise and technologies related to constructing jetties, seawalls, groins, vegetation barriers, beach nourishment, and breakwaters are essential to safeguard ports and shorelines.
- f. **Fishing, Aquaculture, and Marine Products:** Caribbean countries have extensive maritime Exclusive Economic Zones, presenting opportunities in fishing, aquaculture, mariculture, and marine product development. This includes ventures in seaweed-based products and seafood farming, with potential benefits from partnerships that bring knowledge from regions with advanced blue economy sectors.

3.7. Challenges

Investors should consider the following challenges when engaging in the maritime services, ports, and logistics sectors in Caribbean countries [78, 80, 81, 82, 83].

- a. Due to the significant capital required, many opportunities in this sector tend to favour larger companies rather than small and medium-sized enterprises (SMEs). Still, niche markets exist where SMEs can participate. To reduce high transaction costs, companies might explore joint investments and regional partnerships. Entering small-scale markets can be difficult even after multiple attempts, so forming local partnerships is often crucial. Countries like Jamaica, the Dominican Republic, Trinidad and Tobago, and Guyana present more attractive investment prospects because of their larger-scale projects and strong focus on infrastructure development.
- b. Navigating the business and trade environment in the Caribbean can be complex due to bureaucratic hurdles and a relatively low level of digitalization. Obtaining permits, meeting investment requirements, and managing customs procedures can be time-consuming. Having a local partner can greatly ease these challenges. Additionally, some countries, such as Barbados, Dominica, and

Trinidad and Tobago, have established “one-stop shops” to simplify administrative processes. Expanding such services across the region would further streamline procedures for investors.

- c. Projects in the maritime and logistics sectors often require specialized skills and expertise. Because many Caribbean countries are small, they have limited access to qualified human resources. Fortunately, regional agreements facilitate the movement of professionals and business personnel, which can help investors bring in the expertise needed for project success.
- d. Accessing public procurement opportunities can be difficult due to manual and traditional tendering processes. To overcome these obstacles, investors may benefit from partnering with local firms to navigate bidding procedures. There is also a growing push to adopt online procurement platforms in the region, which would improve transparency and accessibility. Examples of such platforms include Jamaica’s Electronic Procurement Platform, the Bahamas’ eProcurement & Supplies Registry System, St. Vincent and the Grenadines’ eProcurement Portal, and Grenada’s Central Procurement Unit. Moreover, chambers of commerce in the region often offer support services to help with tender documentation and submission.

To sum up, the Caribbean maritime sector stands at a crossroads, with its future shaped by both its unique geographic advantages and the challenges of a rapidly evolving global shipping industry. The sector’s strengths, its role as a global trade crossroads, its dominance in cruise tourism, and its potential for blue economy growth, offer a strong foundation for future development. However, realizing this potential will require targeted investments in port modernization, workforce training, and sustainable practices, as well as a renewed commitment to regional cooperation and integration.

While some Caribbean ports are well-positioned to thrive as major logistics and transshipment hubs, others must find ways to remain relevant, whether through niche markets, improved feeder services, or specialized auxiliary offerings. The region’s ability to adapt to technological change, withstand climate-related risks, and balance economic growth with environmental stewardship will ultimately determine its long-term success.

Overall, the Caribbean maritime sector has a bright future if it can overcome its challenges and seize new opportunities. By working together and embracing innovation, the region can continue to play a vital role in global trade while supporting sustainable economic growth for its people.

4. The Pacific Corridor

Products from Mexico and Chile are traded throughout Asia with help from the Pacific corridor, which unites Chile, **Peru, Ecuador, Colombia, Panama, and Mexico** with China, Japan, South Korea, and ASEAN. Trade across the Pacific happens largely with help from San Antonio, Callao, Guayaquil, Buenaventura, and Manzanillo ports. Facing problems in infrastructure and regulations, the region enjoys more open trade, larger seaports, and enhancement in its logistics. Being a leading nation in copper, lithium, wine, and seafood, Chile exports them via sea to places such as Valparaíso and San Antonio in the Pacific. Peru relies on Callao for its minerals and fish exports, whereas Ecuador uses Guayaquil and Manta for sending out bananas, shrimp, and cocoa. More coffee and coal are passing through the Buenaventura port in Colombia, while Mexico's Manzanillo and Lázaro Cárdenas ports ship out more autos, electronics, and avocados. Although Bolivia and Venezuela ship more products abroad, Panama's big influence stems from its canal used in world trade, while they use nearby ports and the corridor for trade with Asia and the Pacific [71].

4.1 Chile: Gateway to the Pacific

- Chile's maritime economy is driven by its narrow geography and reliance on Pacific-facing trade routes. It has embraced port privatization and integrated logistics as core development strategies [30].
- Port of San Antonio and Valparaíso both handle the majority of Chile's containerized exports, especially perishables like grapes, berries, seafood, and wine [84].
- As the world's largest copper producer, Chile depends heavily on maritime transport for mineral exports. Bulk terminals in Antofagasta and Mejillones handle high volumes of concentrate and refined copper [85].
- Chile's expansive network of FTAs 26 agreements that cover 64 economies boosts maritime connectivity and facilitates efficient customs procedures [86].
- Digitalization of Ports is massive and Chile ports are adopting smart solutions to improve container handling efficiency, customs transparency, and intermodal transfer [87].

Cargo throughput and Commodities

A major part of Chile's economy is through the Pacific, with the ports of San Antonio and Valparaíso being very significant. In 2023, San Antonio, the biggest seaport in the country, processed over 21 million tonnes and 1.54 million TEUs, which made up almost half of the nation's cargo. PEXA is designed to help move 6 million containers a year by constructing new terminals and a break wall that is 3,900 meters long. Furthermore, the \$17 million Terminal Intermodal Barrancas will make rail services better and enlarge the space available for cargo. Still, tough sea conditions have interrupted the port's operations. A big investment of \$10 million is needed to fix the breakwater and reach the previous level of efficiency by 2026 [71].

Concurrently, the Port of Valparaíso which handles about 30% of Chile's outside trade, converts to education, research and high tech to deal with its restricted terrain. Thanks to a Port Community System (PCS), the company combines resources, accelerates logistics and is planning to build a new Terminal 2 to enhance its services by providing 1 million extra TEUs by 2030. Despite facing challenges from its location, updated plans allow Valparaíso to stay important for trade activities. As a result of their work together, the country's importance in Pacific maritime trade, especially with Asia-Pacific countries, increases [80].

Freight Transport and Fleet Composition

Chile's maritime industry is fundamental to its foreign trade, managing more than 96% of the country's international cargo. As of 2023, Chile's commerce on the seas is led by 246 merchant vessels, making it a moderate player globally but significant regionally. The fleet experienced a slight contraction with a -2.3% growth rate in 2023 [88]. Out of the fleet, there are mainly container ships, bulk carriers, tankers and general cargo vessels. About 34.6% of Chile's fleet is made up of container ships, underlining how important containerized trade is for the country, especially for processing foods and consumer items bought from overseas. Transporting resources such as copper, coal and grains which play a big role in Chile's economy, depends greatly on bulk carriers. Tankers which make up 18.3% of the fleet, help satisfy Malaysia's increasing demand for energy, while general cargo ships, with 22.8% of the fleet, permit shipping of various products from machinery to food [81].

The entire fleet can handle about 953,000 deadweight tons (DWT). Although Chile's fleet is not large when compared to other nations, it makes up for this by hiring foreign vessels and cooperating with global alliances to secure logistics across the globe. Even with fewer vessels, the Chilean fleet is very useful and designed to meet the country's trade needs, ensuring smooth movement of products through the port system across the Pacific and elsewhere.

4.2. Peru: Mineral and Agro-Industrial Exporter

Peru is increasingly positioning itself as a Pacific trade hub due to its growing exports and improving port infrastructure.

- Port of Callao handles over 70% of Peru's maritime trade and has undergone modernization through investments by DP World and APM Terminals, significantly increasing capacity and reducing turnaround times [89].
- Peru's booming agro-industrial sector grapes, avocados, asparagus, and blueberries depends on refrigerated shipping and dedicated container terminals [90].
- Copper, gold, and zinc are exported from specialized ports along the southern coast, such as Matarani and Ilo [91].
- Peru is part of the proposed BI oceanic Corridor, linking the Atlantic and Pacific through Brazil, Paraguay, and northern Argentina, with Callao as the end point [92].

Cargo throughput and Commodities

As an important Pacific port, Callao Port in Peru is now handling most of the country's trade in minerals, containers, and imports. With the aid of DP World and APM Terminals, it has gone through several important improvements [94]. To avoid using the Panama Canal, China Ocean Shipping Company (COSCO) plans to develop Chancay Port to promote more Asian trade. When the project is finished, it would be able to handle 6 million twenty-foot equivalent units per year. Copper, gold, blueberries, and avocados are Peru's main exports to China, South Korea, and the U.S., at the same time importing machinery, electronic devices, and fuel. There is also an increase in trade between the U.S. and Japan and South Korea, which proves the region's significance [82].

Freight Transport and Fleet Composition

Due to the country's extensive 2,400 km coastline, using ships to ship out heavy items, food, and manufactured goods is the main option for Peru. A large share of exports by mining, agriculture, and fishery sectors in Peru goes to nations in the Asia-Pacific zone and the US via sea routes [94].

In Peru, most of the maritime freight consists of bulk cargo (of raw copper, grains, fishmeal, and gold), containerized cargo (with goods, machinery, electronics, and perishables), and Ro-Ro cargo (loaded onto ship decks) [95]. Small items can be handled and followed using containers, and Ro-Ro facilities make it simple to transport automobile and heavy machinery out of Callao. Peru's maritime freight is led by the Port of Callao, handling over 80% of container traffic and acting as the country's logistics hub. In 2024, the national port system moved 127.8 million tonnes, including 3.5 million TEUs, with Callao covering nearly 88% of containers [96]

The new Port of Chancay, inaugurated in 2024, is set to boost Peru's trans-Pacific connectivity with a 1-million TEU capacity. Despite this, Peru ran a US \$2.58 billion transport services trade deficit in 2023. The national fleet counts 111 ships (446,000 DWT), dominated by oil tankers. Offshore data shows nearly 38% of Peru-flagged vessels are oil product tankers, with the rest spread across LPG carriers, fishing vessels, and tugs [97].

4.3. Ecuador: Trade Gateway to America

Most of Ecuador's shipping along the Pacific Ocean involves three important ports, Guayaquil, Manta and Posorja, which manage different types of goods important to the country. Managing reefer containers, Guayaquil is the main gateway for Ecuador's main exports, bananas, shrimp, tuna and cocoa, as it keeps their perishables good for transport to North America, Asia and Europe [98]. Most of Manta's activities include moving bulk products such as wheat, vegetable oils and things related to fishery and handling Ro-Ro cargo that aids in moving vehicles and heavy equipment for mining and construction. There are also containers of manufactured.

Cargo throughput and Commodities

Trade with the Pacific countries go mainly through the ports of Guayaquil, Manta, and Posorja in Ecuador. About eighty percent of Guayaquil's non-oil exports, which are bananas, shrimp, tuna, cocoa, and precious metals, are sent to the US, China, and Europe. In Manta, companies send out tuna, wheat, and import cars, whereas Posorja has been made to be a major deep-water port that welcomes container ships. Continual improvements at Ecuador's coastline ports are made to handle more goods, save time, and help the country grow its trade with America.

Freight Transport and Fleet Composition

The national fleet counts about 153 vessels (approx.308,100 DWT), dominated by oil tankers, with smaller shares in general cargo and container ships. Specialized players include PCL (Galápagos shipping), NIRSA (largest fishing fleet), and Ecuafleet/Ecuafleet (hydrocarbons). Fleet capacity has slightly contracted since 2015, but port upgrades and private operators are strengthening Ecuador's role in regional and global shipping [99].

4.4. Colombia: Gateway for Regional and Transoceanic Trade

Colombia's location on both the Caribbean Sea and Pacific Ocean gives it a strategic advantage for both regional and transoceanic trade.

- Port of Cartagena is the leading transshipment hub in the Caribbean. Cartagena boasts deep-water berths, extensive free trade zones, and efficient customs. It serves Central America, the U.S., and Europe [100].
- Buenaventura Port is Colombia's main Pacific port and is critical for trade with Asia. However, it faces challenges related to congestion, social unrest, and underinvestment [101].
- Colombia is increasing its maritime exports of chemicals, coffee, coal, and petroleum. Infrastructure upgrades are being supported by public-private partnerships [102].

Cargo throughput and Commodities

About 60% of Colombia's maritime cargo and 19.75 million tons were handled by the Port of Buenaventura in 2022 in Pacific trade mainly. The main export items of Colombia are coffee, coal (1.1 million tons in 2023), and oil that is sent out via pipelines. There are 14 berths in Buenaventura's container terminal that allow major vessels to dock, though the place struggles with infrastructure issues and disagreements in its area. Therefore, the government of Colombia is spending \$600 million on new infrastructure and container handling to increase the efficiency of global trade through the port [103].

Freight Transport and Fleet Composition

At present, maritime freight is very important for Colombia's international trade, since nearly 80% of products are transported through its seaports. In Colombia, coal, coffee and petroleum are mainly

exported from Cartagena, Barranquilla, Santa Marta (in the Caribbean) and Buenaventura and Tumaco (in the Pacific). Imports of goods made by industry are brought in through those and other major ports as well. 65 percent of the nation's total imports are managed at Buenaventura, showing its significance. The Colombian merchant fleet contains 17 large vessels (bulk carriers, cargo ships, a container ship, gas carrier and petroleum tankers), but seven more ships are Colombian owned even though they are registered under different countries' flags.

The total number of ships registered in the country adds up to 153 vessels, with a combined deadweight of about 99,000 tons such as general cargo and oil tankers and more. COTECMAR, a state-owned shipbuilding company based in Cartagena, is in charge of producing and taking care of Colombia's naval and commercial ships. These aspects are key to Colombia's logistics and trade and efforts to update them are aimed at making trade and business more efficient [104].

4.5. Panama: Regional Maritime Hub

Though not a South American country, Panama's maritime system significantly influences the southern continent's trade flows.

- Panama Canal is the strategic chokepoint for global maritime trade, the canal facilitates inter-oceanic shipping between Asia and South America's east coast. It is essential for the transport of grain, LNG, and containerized goods [105].
- Colón and Balboa Ports act as redistribution points for transshipment to and from South America. Operated by global port operators like PSA and Hutchison Ports, these terminals provide advanced infrastructure and intermodal connectivity [106].
- Panama offers a full suite of services flag registry, ship finance, maritime law, and training centres that support shipping operations for South American nations [107].

Cargo throughput and Commodities

Balboa and PSA Panama Pacific terminals played a big role in Panama's transshipment, with a cargo of 3.9 million TEUs handled in 2023. Hutchison Ports and PSA International oversee the operations and efficiently handle containers, bulk items, cars, and other types of cargo. Every year, Balboa assists in trading with Asia and Latin America by handling 2.3 million TEUs, whereas PSA Panama specializes in electronics and copper imports and bananas exports with a throughput of 1.6 million TEUs. Despite not producing much internally, Panama is a main logistics hub because of its rich ports [108].

Recently, after the second inauguration of the Trump administration in the USA, new discussions about the future of the canal started since Donald Trump demanded from Panama a reduction of the fees on the Panama Canal or a return of the canal under US control. The new US president accused the central American country of charging "exorbitant prices" to American shipping and naval vessels according to international media. These political comments of the US president were quickly rebuked from Panama's

president, who said "every square metre" of the canal and surrounding area belong to his country. The US president additionally complained concerning the Panama Canal that besides the "high transit fees for U.S. ships crossing the Panama Canal" also on the Chinese influence in Panama and the canal zone demanding a Panama-China break-up [173].

Freight transport and Fleet Composition

Panama's fleet is unique because it is dominated by its role as the world's largest open ship registry, rather than by a domestically owned fleet. As of 2023, more than 8,500 vessels fly the Panamanian flag, accounting for about 16% of the world's deadweight tonnage (DWT). The composition is heavily weighted toward bulk carriers and oil tankers, which together make up over half of the registered tonnage. Container ships also represent a significant share, reflecting Panama's role in global liner shipping, while smaller segments include general cargo ships, LNG carriers, and specialized vessels [109]. Additionally, while Panama dominates in fleet size and DWT, registry reforms point to ongoing efforts to modernize. In 2024, an additional 468 vessels were added, including 408 newbuilds composition.

5. Atlantic Market - The MERCOSUR and Mexico

The Atlantic Ocean covers over 20% of the Earth's surface and accounts for approximately 29% of its total water surface [110]. The South American coasts form part of the western shores of the South Atlantic Ocean and countries with Atlantic coastlines are called Caribbean states such as Cuba, Jamaica, Panama, Colombia, and Venezuela, as well as South American nations such as Argentina and Brazil.

The main economic hotspots of the Latin American region include Brazil, Argentina, Uruguay, and Paraguay, which are the core members of the MERCOSUR alliance. On 6 December 2024, the European Union and the four MERCOSUR countries, namely Argentina, Brazil, Paraguay, and Uruguay reached a political agreement on a landmark partnership arrangement. Early September 2025, the European Commission initiated the ratification process for the new EU–MERCOSUR Partnership Agreement (EMPA) [174].

On the hand, Bolivia and Venezuela are currently not part of the EU–MERCOSUR agreement. Venezuela, though formally a member, has been suspended since 2016, while Bolivia is an acceding member awaiting full ratification. Mexico is also not a MERCOSUR member; however, it remains a strategic trade partner. While MERCOSUR constitutes the core of South American economic integration (Figure 12), Mexico's geographic position and robust trade ties with both North and South America make it a key player in the broader Atlantic market.

Ports along the Atlantic coast handle a wide range of cargo types, including bulk commodities, agricultural exports such as grains and soybeans, petroleum products, containerized manufactured goods, and consumer imports. Through these activities, they connect the economies of the region with markets in North America, Europe, Africa, and beyond [111].



Figure 12. The MERCOSUR Map / Source: *Unctad* [112].

5.1. Brazil

With 97.2% of all export and import volumes in 2024, Brazilian ports cemented their role as international trade facilitators [113]. The sector is overseen by the National Waterway Transport Agency (ANTAQ), with major port authorities (e.g. Companhia Docas do Estado de São Paulo at Santos) and many private terminal operators (e.g. DP World, Hutchison, APM, local stevedores) managing terminals. The value of maritime trade in 2024 was \$492.5 billion, up 2.24% from 2023, according to a study by the Research and Development Division of the Private Port Terminals Brazilian Association (ATP).

Brazil operates several ports including the Latin America's largest container port, Santos, Paranaguá, Rio de Janeiro, Itajaí, Suape, Vitória and Santos/Paranaguá inland terminals.

Cargo throughput and Commodities

In the year 2023 Brazil exported merchandise worth 339,696 million US\$, which is an enormous increase from 186,782 million US\$ in 2015 [114]. Key exports are iron ore (107.5 Mt in Q3 2023), soybeans and soybean products (24.3 Mt of soy in Q3 2023), corn (31.6 Mt), pulp/cellulose, meat, and crude oil (57.3 Mt) [115]. Vehicles, electronics, fuel, chemicals, and machinery are among the major imports [116]. China, the United States, and the European Union are Brazil's principal trading partners via the Atlantic, along with its neighbours in the region (such as Argentina and Paraguay). Busiest are the transatlantic routes (Brazil–Europe) and the routes from Brazil to Asia through the Cape of Good Hope or the Panama Canal.

Freight Transport and Fleet composition

Brazil's shipping connectivity index has maintained steady performance since 2018, demonstrating resilience in the face of regional volatility. Only domestic entities are permitted to ship between domestic ports in Brazil. Cabotage is only permitted by Brazilian Navigation Companies, or Empresas Brasileiras de Navegação (EBNs). The detailed fleet composition [114]

Significant technological advancements have occurred in this sector, especially in the areas of vessel tracking systems and port operations. A joint venture to build a dedicated port terminal for grains and fertilizers at the Port of Santos was announced in March 2024 by DP World and Rumo, Brazil's top railway operator. The project aims to increase the port's yearly capacity by 12.5 million tons, with 3.5 million tons going toward fertilizers and 9 million tons going toward grains. The logistics market in Brazil is still dominated by the road freight transportation sector, with heavy trucks making up more than half of all new truck registrations in 2022 (65,000 units) [117].

5.2. Argentina

On Argentina's Atlantic coast are the principal ports of Bahia Blanca, Buenos Aires, Comodoro Rivadavia, La Plata, and Mar del Plata. The southernmost point of the Atlantic and Pacific Oceans is marked by Ushuaia at Cape Horn, while the inland river ports of Rosario and Santa Fe are located there. Argentina's waterborne freight transport is projected to slightly decline from 64.19 billion ton-kilometres in 2019 to 61.45 billion ton-kilometres by 2029 [118].

Cargo throughput and Commodities

In 2023, Argentina's container ports handled 1,490,437 TEUs (Twenty-foot Equivalent Units). Argentina's maritime exports are dominated by bulk agricultural commodities, energy products, and some manufactured goods. In 2023, the total value of merchandise exports was \$66.8 billion, with imports at \$73.7 billion, resulting in a trade deficit. Soybean meal, oil, and beans remain Argentina's leading export commodities, shipped primarily in bulk. Corn and wheat are major contributors to bulk cargo throughput. Crude oil and refined petroleum products are significant for liquid bulk shipping, with oil tankers representing the largest segment of the national fleet. Other agricultural products, including beef, wine, and fruits, often shipped as refrigerated or general cargo. Argentina imports a mix of manufactured goods, machinery, chemicals, and fuels, much of which arrives in containers or as breakbulk cargo [119].

Freight transport and Fleet Composition

Argentina's fleet of ships exhibits a clear division between those owned by Argentine companies registered abroad and those flying the national flag. 197 active ships with a combined carrying capacity of 859,000 deadweight tons (DWT) make up the national flag fleet as of 2023. Oil tankers dominate the fleet's carrying capacity at 527,300 DWT (61% of total national flag DWT), Bulk carriers account for 29,100 DWT (3.4%), while general cargo vessels and container ships represent smaller segments at 10,400 DWT (1.2%) and 15,000 DWT (1.7%) respectively and various specialized vessels, contributes 277,200 DWT (32.3%) [119]. Argentina's freight transport network is centred on important maritime hubs; on average, 6.8 million tons of imports and 5.9 million tons of exports are handled annually by the Port of Buenos Aires [120]. The fleet primarily carries general cargo amounting to 10.8 million tons, and containerized cargo, with more than 1.1 million TEUs processed. Finished goods (2.8 million tons), fuels (1.8 million tons), and substantial amounts of chemical products, iron, steel, cars, and auto parts are among the diverse range of goods that make up freight.

5.3. Paraguay

One of the two landlocked nations in Latin America is Paraguay; the other is Bolivia. The country utilizes fluvial shipping by utilizing the Hidrovía Paraguay-Paraná (HPP), which acts as the key transportation route for Paraguay, transporting 70 percent of the country's exports and 50 percent of its

imports. In 2023, 26 million tons of Cargo (Figure were transported the sections surrounded by Brazil, Bolivia and Paraguay [121]. Key exports traversing the river system are agricultural commodities (especially soybeans, corn and other grains, and their derivatives) and mineral bulk (notably iron ore) [122].

Cargo throughput and Commodities

Recent data indicate around 25–30 million tons per year transit the Paraguay/Paraná sections serving Paraguay. Soybeans and soy products make up about half of this commodity, with corn and other grains making up the majority of the remaining amount (67% of the 12 million tons of exports) (Figure 7), along with ore and other bulk materials. Since most Paraguayan cargo moves in bulk, containerized throughput is much smaller, averaging about 38,000 TEU annually (or 37.9 K TEU in 2020) [123]. In 2023, the HPP carried 17 million tons of imports and exports for Paraguay in particular. Due to its higher cost, general cargo accounted for 48% of the total value of imports in 2023, despite only making up 26% of the volume of imports.

Freight Transport and Fleet Composition

Paraguay has one of the biggest fleets of inland barges in the world. It actually possesses the third-largest tug-and-barge fleet in the world, after China and the United States. The Paraguayan flag, which is flown by about 90% of the vessels in the HPP, mandates that all of the crew members be Paraguayans. According to an ECLAC transport report, the Paraguayan inland fleet comprises roughly 3,445 craft. The Paraguayan economy depends heavily on the shipping industry, which generates about \$1.1 billion in gross output, \$0.7 billion in GDP (or 2% of GDP), and 26,000 jobs (or 6% of all private, formal employment) [121]. The Paraguayan maritime transport focus on sustainability, by adopting one of the most ecologically friendly modes of transportation, that is the use of river tows. On a ton-mile basis, river shipping is up to 85.9 times more carbon efficient than air travel, roughly 12.0 times more carbon efficient than road travel, and roughly 1.2 times more carbon efficient than rail travel. By 2030, it is anticipated that the amount of cargo carried on the HPP will rise from 24 million to as much as 55 million tons.

5.4. Uruguay

Uruguay has become a modern logistic hub for products distribution to the region due to strategic location, easiness of doing business and airports laws, as well as quality and reliable services. The Uruguay Freight and Logistics Market size is estimated at 3.94 billion USD in 2025 and is expected to reach 5.09 billion USD by 2030 [124]. In 2023, Uruguay's maritime trade was characterized by a total merchandise trade value of USD 21.7 billion, with exports amounting to USD 9.2 billion and imports at USD 12.5 billion, resulting in a trade deficit of USD 3.3 billion. The Port of Montevideo, Uruguay's primary maritime gateway, is undergoing significant modernization to enhance its capacity and

efficiency. The modernization of the Port of Montevideo presents significant opportunities for U.S. companies.

Cargo throughput and Commodities

In 2023, Uruguay's main ports handled a container throughput of 1,080,445 TEUs, underscoring the country's importance as a transshipment and distribution centre for the Southern Cone, particularly for trade with Brazil, Argentina, and Paraguay [124]. The main cargo throughput and commodities are agricultural raw materials, manufactured goods, food items and other food types. The commodities most prominently featured in Uruguay's maritime activities are food products, which account for 66% of the country's maritime exports [125]. This includes beef, dairy products, rice, and other agricultural goods. Agricultural raw materials make up 14% of maritime exports, reflecting Uruguay's strong forestry and crop production sectors (notably cellulose and soybeans). Manufactured goods represent 19% of maritime exports, while other products account for just 1%. Overall, Uruguay's maritime trade is dominated by food and agricultural commodities, highlighting the country's role as a major exporter of high-quality agricultural and processed food products through its ports.

Freight Transport and Fleet Composition

As of 2023, Uruguay's national merchant fleet consisted of 58 ships with a total carrying capacity of 47,000 deadweight tons (DWT), which represents a 22% decline in fleet size compared to the previous year [125]. The fleet is diversified by ship type: oil tankers: 6,700 DWT for transporting petroleum products, general cargo ships: 7,400 DWT for breakbulk and miscellaneous cargo, container ships: 3,100 DWT for containerized goods and other types. The remaining capacity is distributed among other specialized vessels.

5.5. Venezuela

Venezuela's maritime industry remains cantered on oil exports, with recent geopolitical shifts causing major disruptions and prompting a strategic pivot toward alternative markets. The sector faces ongoing uncertainty but is adapting through new trade partnerships and a focus on data-driven maritime analytics. Venezuela's maritime profile in 2023 reflects a sector shaped by the country's oil-dominated economy and recent shifts in trade. The national fleet comprised 269 ships with a total carrying capacity of 1.314 million deadweight tons (DWT), though this marked a decline from previous years [126].

Cargo throughput and Commodities

Venezuela's cargo throughput and commodity trade are defined by its overwhelming dependence on hydrocarbons, which dominate both the structure and value of exports. In 2023, merchandise exports were \$7.8 billion, while imports were higher at \$10.945 billion, leaving the country with a trade deficit of \$3.145 billion. The export basket was heavily skewed toward fuels, which accounted for 86% of total

exports that shows Venezuela's deep reliance on the oil industry. Manufactured goods contributed 11%, while other products, including limited agricultural and raw material exports, made up only 3% [126].

Despite this narrow concentration, the country witnessed a 64.2% rebound in export performance in 2023 compared to 2022, marking a partial recovery from years of contraction linked to sanctions, declining oil production, and infrastructural constraints. Venezuela's main trading partners reflect its strategic ties across Asia, the Americas, and Europe: India (\$2.291 billion), the United States (\$1.703 billion), China (\$1.563 billion), Spain (\$320 million), and Singapore (\$298 million) were the top five destinations for Venezuelan exports. This mix depicts both the importance of Asian markets for crude sales and the country's ongoing, though diminished, integration with Western economies. Overall, Venezuela's cargo throughput illustrates a highly oil-dependent export model, limited diversification, and a fragile recovery that hinges on both geopolitical conditions and the performance of its petroleum sector [127].

Freight Transport and Fleet Composition

The Venezuelan merchant fleet under national flag comprised 269 ships with a total carrying capacity of 1,314,000 deadweight tons (DWT), marking a decline from previous years. Oil tankers dominate this fleet, accounting for 632,800 DWT, followed by bulk carriers at 233,400 DWT, general cargo ships at 113,600 DWT, and other types of vessels at 334,100 DWT. Notably, there were no container ships registered under the national flag in 2023.

5.6. Bolivia

Bolivia, as a landlocked country, does not have direct maritime cargo throughput through its own ports, which fundamentally shapes its maritime industry and trade logistics. Instead, its "maritime" activities are focused on the use of ports in neighbouring countries, especially in Chile (Pacific coast) and Brazil and Argentina (Atlantic coast) through multimodal transport corridors. The country's strategic location at the heart of South America gives it the potential to act as a connecting hub between the Andean Community (CAN) and MERCOSUR, as well as between the Pacific and Atlantic Oceans [127].

Cargo throughput and Commodities

In 2023, Bolivia's merchandise exports totalled \$10.91 billion, and imports reached \$11.50 billion, resulting in a trade deficit of \$585 million. The export structure was dominated by food and live animals (34% of exports), crude materials excluding fuels (28%), manufactured goods (21%), and mineral fuels and lubricants (13%), reflecting a strong focus on agricultural and raw material commodities.

The country has no coastline and therefore no container port throughput or port calls recorded for 2023. Bolivia's national fleet consists of 50 ships with a total carrying capacity of 130,000 deadweight tons (DWT), showing a modest growth of 3.7% over the previous year. This fleet is primarily composed of general cargo vessels (98,500 DWT), with smaller segments for oil tankers (14,700 DWT) and other

types of ships (17,300 DWT); there are no bulk carriers or container ships registered under the Bolivian flag. The majority of Bolivia's international trade relies on multimodal transport corridors to access seaports in neighbouring countries, particularly Chile, Peru, Brazil, and Argentina. As a result, Bolivia's maritime trade is highly dependent on foreign port infrastructure, and its domestic fleet plays a minor role in overall trade logistics, mainly supporting river and inland waterway transport rather than ocean-going shipping [128].

5.7. Mexico

Mexico, with extensive coastlines along both the Pacific Ocean and the Gulf of Mexico, plays a central role in the maritime economy of the Americas. While MERCOSUR countries are known to be the backbone of South American trade, Mexico bridges the North and Central America, expands the Atlantic market's reach and diversifies the trade flow. Its participation in free trade agreements and strategic positioning enhances commercial interactions across the Atlantic, complementing MERCOSUR's economic network. Unlike landlocked countries such as Bolivia, Mexico's trade is directly shaped by its seaports, which serve as major gateways for both exports and imports. The country's geographic advantage provides access to two oceans, enabling it to act as a strategic link between Asia, North America, and Europe. This dual-coast configuration has positioned Mexico as both a regional hub and a potential competitor to traditional routes such as the Panama Canal [129]. While Mexico's national fleet plays a relatively modest role in containerized global trade, its port infrastructure has emerged as one of the strongest in Latin America. The reliance on foreign shipping lines is offset by the sheer scale and efficiency of Mexican seaports, which continue to expand capacity and capture a growing share of transpacific and intra-American cargo [130].

Cargo Throughput and Commodities

In 2024, Mexico's seaports handled record levels of cargo. Between January and April alone, containerized throughput reached 2.95 million TEUs, an 18.2% increase compared to the same period in 2023 [131]. The Pacific coast dominated operations, led by the Port of Manzanillo, which processed nearly 4 million TEUs in 2024 and continues to expand toward a long-term capacity of 10 million TEUs. Similarly, Lázaro Cárdenas experienced remarkable growth, with container volumes increasing by 35% year-on-year, consolidating its role as a deep-water port for large Asia–Mexico and transpacific traffic.

On the Atlantic side, Veracruz has emerged as the busiest Gulf port, recording 424,949 TEUs from January to April 2024, a 21% increase from the previous year. Altamira also strengthened its position with 288,187 TEUs, up 7.5% during the same period. This strong performance illustrates Mexico's balanced development across both coasts, ensuring access to global markets via the Pacific and Atlantic gateways [132].

Freight Transport and Fleet Composition

According to UNCTAD's Maritime Profile [131], Mexico's national-flagged fleet comprised 675 ships with a total carrying capacity of around 2.1 million deadweight tons (DWT). This marks steady growth from 1.94 million DWT in 2015, underlining the country's increasing role in maritime logistics

The fleet is dominated by oil tankers (888,000 DWT), reflecting the strategic importance of Mexico's petroleum industry. Other significant segments include general cargo vessels (56,500 DWT), bulk carriers (114,000 DWT), and miscellaneous vessel types (over 1 million DWT combined). Notably, no container ships are registered under the Mexican flag, a pattern common in many developing maritime economies, where containerized trade relies heavily on foreign carriers rather than domestic fleets.

6. Panama Channel

The Panama Canal (Figure 13) is approximately 80 kilometres long and connects the Atlantic and Pacific Oceans. This waterway was cut through one of the narrowest saddles of the isthmus that joins North and South America. The Canal uses a system of locks compartments with entrance and exit gates. This locks function as water lifts because they raise ships from sea level (the Pacific or the Atlantic) to the level of Gatun Lake (26 meters above sea level) so that the ships can sail the channel through the Continental Divide.



Figure 13. *Panama Canal / Source: Unctad [112].*

Ships from all parts of the world transit daily through the Panama Canal and about 13 to 14 thousand vessels use the Canal every year. In fact, commercial transportation activities through the Canal represent approximately 5% of the world trade that demands a work force of approximately 9 thousand employees and operates 24 hours a day, 365 days a year [133].

Panama stands as a critical maritime hub, benefiting from its strategic geographic location at the nexus of global trade routes linking the Atlantic and Pacific Oceans (Table 3). According to recent UNCTAD reports, Panama's population reached approximately 4.46 million in 2023, while the country's gross domestic product (GDP) stood at around US\$82.4 billion, supported by a solid annual growth rate of 6.06%. The maritime sector forms a cornerstone of Panama's economy, serving as both a catalyst for domestic development and a conduit for international trade [134].

Transport services, driven predominantly by maritime trade through the Panama Canal, are particularly significant in Panama's economic landscape. In 2023, these services accounted for approximately 52.2% of the country's services exports, translating to an export value of US\$9.12 billion. Imports of transport services, meanwhile, were estimated at US\$2.82 billion. These figures highlight the strategic importance of the maritime sector in sustaining Panama's trade balance and economic growth [135].

Table 3. *International Trade in Service in Panama / Source Unctad [2].*

Total trade in services (millions of US\$)			
Year	Services exports	Services imports	Services trade balance
2005	3,234	1,813	1,421
2010	6,834	2,827	4,007
2015	11,866	4,824	7,042
2023	17,473	5,955	11,518
Services exports by main category (% of total services)			
Year	Transport	Travel	Other services
2005	55.5%	24.1%	20.3%
2010	50.1%	25.5%	24.3%
2015	45.8%	33.3%	20.7%
2023	52.2%	31.2%	16.5%

For decades, the canal's original locks dictated the maximum vessel dimensions. Few waterways have influenced the evolution of global shipping as profoundly as the Panama Canal. The terms Panamax, Neo-Panamax, and later ULCV are not only measures of vessel size, but milestones in how maritime trade has adapted to the physical limits of this critical passage such as the channel. Each of these ship categories has had a significant impact on global shipping, reshaping the industry and influencing trade routes worldwide[135].

Panamax

Panamax ships were specifically designed to transit the original locks of the Panama Canal, earning their name from the canal's dimensional constraints. These vessels have played a vital role in international trade for decades. Key specifications include:

- **Maximum Length:** Approximately 294 meters (965 feet)
- **Maximum Width (Beam):** Approximately 32.3 meters (106 feet)
- **Maximum Draft:** Approximately 12 meters (39.5 feet)
- **Container Capacity:** Approximately 4,500 to 5,000 twenty-foot equivalent units (TEUs)

These vessels served as the standard for container shipping through the canal prior to the 2016 expansion, facilitating trade between the Atlantic and Pacific Oceans.

Neopanamax

Neo-Panamax ships emerged following the completion of the Panama Canal Expansion Project in 2016, which introduced a new set of locks capable of accommodating larger vessels. These ships are designed to maximize the expanded canal's potential and enhance global trade efficiency. Their specifications include:

- **Maximum Length:** Approximately 366 meters (1,201 feet)
- **Maximum Width (Beam):** Approximately 49 meters (161 feet)
- **Maximum Draft:** Approximately 15 meters (49.2 feet)
- **Container Capacity:** Typically, between 13,000 and 15,000 TEUs

Neo-Panamax ships have significantly increased the volume of cargo that can transit the canal, contributing to reduced transportation costs and improved global supply chain connectivity.

Ultra Large Container Vessel (ULCV)

ULCVs represent the largest container ships currently operating on major trade routes. While they surpass the Panama Canal's capacity even after its expansion, they have redefined the scale of maritime transportation by transporting massive quantities of cargo across the world's oceans. Notable specifications of ULCVs include:

- **Length:** Exceeding 400 meters (1,312 feet)
- **Width (Beam):** Up to 59 meters (193.6 feet)
- **Draft:** Up to 16 meters (52.5 feet)
- **Container Capacity:** Over 23,000 TEUs

These vessels operate primarily on Asia-Europe and trans-Pacific routes, requiring deep-water ports and specialized terminal infrastructure.

6.1. History of Panama Channel from Maritime Sector

a. Pre-Construction

Before the canal's existence, maritime trade between the Atlantic and Pacific faced significant challenges. The primary route involved navigating around South America's Cape Horn, a journey that could take up to 180 days this created strong demand for a faster connection between the oceans [136].

b. Construction and Opening

The Panama Canal officially opened in 1914, following a decade-long construction by the United States, after resuming work from a bankrupt French initiative. The total cost was around \$400 million [9]. In addition, the canal's market position strengthened significantly during this period because it

- Provided massive cost savings for intercoastal commerce
- Supercharged West Coast growth
- Generated economic benefits equivalent to 4% of America's national income by 1940
- Maintained low transit rates under U.S. public ownership [137].

c. Growth in Shipping Traffic

In its first year, the canal saw fewer than 1,000 ship transits, but by the 1960s it reached approximately 14,000 transits annually, reflecting rapid growth as shipping volumes and global maritime trade expanded shown in Figure 14. This elevated level of annual transits held relatively steady into the 21st century until 2024, when extreme water shortages caused by drought reduced annual transits to around 12,000 ships shown in Figure 14, while also increasing waiting times [136].

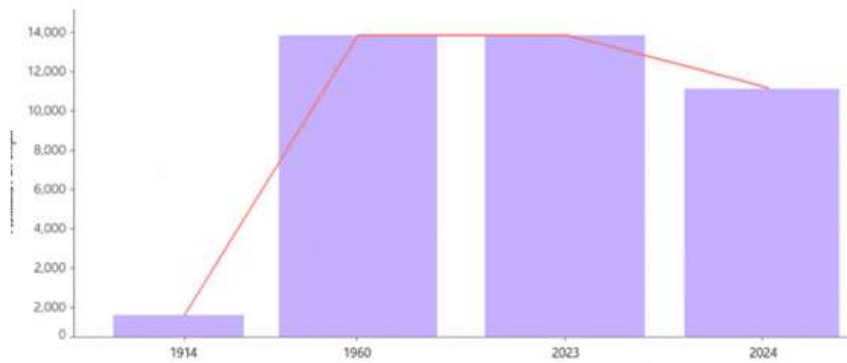


Figure 14. Panama Canal Ship Traffic Overtime / Source : Jose Ramón Icaza Clément et al. [109].

d. Canal Management Revenue

Upon transfer of canal control from the U.S. to Panama in 1999, the Panama Canal Authority (ACP) shifted from a break-even operating model to one with profit-driven tolls. Toll rates per ton effectively doubled, reflecting Panama's centralized control and commercial orientation [137].

6.2. Current Situation Panama Channel from Maritime Sector

As shown in Figure 15, the Panama Canal continues to serve as a crucial artery for global maritime trade, handling a total of 8,057 oceangoing vessel transits in fiscal year 2025, with Panamax locks accounting for 5,876 transits (72.93%) and Neopanamax locks handling 2,181 transits (27.07%) Container ships are the largest single market segment, representing a significant 59.1% of Neopanamax traffic, highlighting the growing role of larger vessels in global logistics. Dry bulk, chemical tankers, and general cargo remain heavily reliant on Panamax locks, showing a more traditional trade pattern. In contrast, LPG carriers demonstrate a marked shift towards Neopanamax use, aligning with broader fleet modernizations. Overall, the canal's operations reflect a dynamic interplay between legacy Panamax ships and the increasing adoption of Neopanamax vessels, with both segments essential for balancing trade flows and sustaining the canal's strategic role in maritime transportation [138].

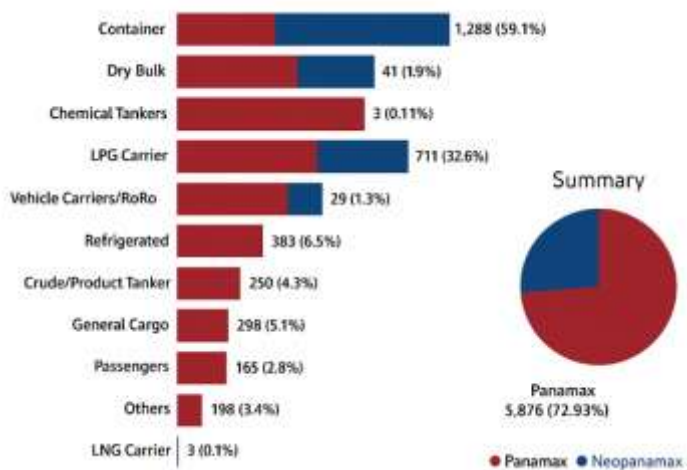


Figure 15. Cumulative Oceangoing Transit in Panama Canal – May – fiscal Year (Autoridad del Canal de Panamá [138])

Table 4 shows that the Panama Canal's trade flows are led by the United States, accounting for 74.7% of total cargo (160.1 million long tons), followed by China (21.4%), Japan (14.3%), and the Republic of Korea (9.2%). Significant trade also comes from Chile, Mexico, Peru, and Ecuador. This highlights the canal's critical role in connecting the Americas with Asia and supporting global trade.

Table 4. *Top Origin and Destination in Panama Canal / Source: Autoridad del Canal de Panamá [138].*

Country	Origin	Destination	Intercoastal	Total	Total Excluding Intercoastal	%
United States	99,627,938	57,434,100	3,059,031	160,121,069	157,062,038	74.7%
China	23,801,407	21,241,347	—	45,042,754	45,042,754	21.4%
Japan	5,292,370	25,437,768	—	30,730,138	30,730,138	14.4%
Korea, Republic of	11,330,537	8,338,453	—	19,668,991	19,668,991	9.2%
Chile	7,803,167	9,620,743	—	17,423,910	17,423,910	8.3%
Mexico	7,298,569	10,015,580	411,793	17,725,942	17,314,148	8.2%
Peru	6,062,353	9,643,313	—	15,705,666	15,705,666	7.3%
Ecuador	5,720,572	7,457,635	—	13,178,207	13,178,207	6.1%
Colombia	4,268,356	5,829,470	248,990	10,346,816	10,097,826	4.6%
Panama	603,942	9,290,076	31,364	9,925,382	9,894,018	4.6%
Guatemala	757,859	6,719,994	8	7,477,860	7,477,852	3.5%
Canada	3,215,769	1,705,872	196	4,921,837	4,921,641	2.3%
Spain	2,338,919	1,563,981	—	3,902,901	3,902,901	1.9%
Taiwan, Province of China	2,254,773	1,250,955	—	3,505,728	3,505,728	1.7%

The Panama Canal continues to be a critical maritime trade artery, facilitating the movement of a diverse array of commodities between global markets. According to the Panama Maritime Review 2024-25, the Canal reported consistent trade flows despite challenges posed by water scarcity, climate variability, and operational adjustments (Table 5).

In terms of commodities, animal and vegetable oils remained significant, with steady northbound and southbound volumes (around 1.8 million long tonnes each way). Food and refrigerated cargo, including meat, fish, and produce, also showed stable flows. Containers, by far the largest single category, accounted for over 35 million long tones northbound and approximately 31 million tonnes southbound. Other notable commodities included coal and coke, grains, and chemicals, all of which maintained solid throughput levels [139].

Table 5. *Commodities in Panama Canals / Source Panama Maritime Review 2024-2025 [139].*

Commodities	2023		2024	
	Northbound	Southbound	Northbound	Southbound
Animal / Vegetable	1,864,948	139,031	1,648,936	191,370
Oils and Fats				
Canned and Refrigerated Foods	387,632	50,301	323,400	65,781
Chemical and Petroleum Chemicals	4,154,207	13,047,672	3,002,638	9,523,814
Coal and Coke (excluding pet. coke)	3,464,636	10,341,124	367,911	2,911,550
Container Cargo	43,549,419	19,469,479	43,368,777	19,416,906
Grains	3,650,839	32,168,588	1,316,466	12,013,999
Lumber and Products	382,156	1,900,465	498,980	1,363,561
Machinery and Products	4,069,391	1,939,637	3,670,777	1,548,952
Manufactures of Iron and Steel	8,089,627	823,501	5,789,414	348,366
Mineral	6,584,243	35,431	2,677,842	72,382
Miscellaneous				
Miscellaneous	7,233,423	1,823,891	5,218,607	1,147,597
Miscellaneous	728,141	2,304,200	668,594	2,441,634
Hazardous Cargo				
Nitrates, Phosphates and Potash	4,514,464	4,908,314	2,966,426	3,114,721
Ores and Metals	7,466,748	3,439,852	4,230,991	1,433,530
Other Agricultural Commodities	902,187	376,634	389,791	57,453
Petroleum and Petroleum Products	6,489,222	83,215,428	4,439,098	68,625,300
Unclassified	2,559,669	3,704,770	2,285,818	3,165,464
Total	106,090,954	179,688,319	82,864,466	127,442,381

While chemicals and minerals remained steady, petroleum and petroleum products registered robust trade volumes, exceeding 4 million long tones in both directions. However, the Canal Authority noted challenges from fluctuating water levels, leading to adjusted daily transit slots to optimize passage efficiency.

Overall, despite operational restrictions and environmental pressures, the Panama Canal remains a pivotal hub for key global commodities, ensuring sustained connectivity in global maritime trade.

6.3. Current Challenges

The severe drought affecting the Panama Canal is primarily driven by climate variability and long-term climate change. The canal relies on Gatun Lake for freshwater, but below-average rainfall (exacerbated by El Niño conditions) has led to critically low water levels. Data shows that 2023 rainfall was 30-50% below normal, making it one of the driest years on record. Rising regional temperatures have further intensified evaporation, reducing the lake's capacity to sustain normal canal operations. This crisis highlights the canal's vulnerability to shifting weather patterns, as its original design assumed consistent rainfall, which is no longer guaranteed in a warming climate [140].

The drought has had severe ecological consequences, particularly on Gatun Lake and surrounding rainforest ecosystems. Lower water levels disrupt aquatic habitats, threatening fish populations and other wildlife that depend on the lake. Additionally, the reduced flow of freshwater increases salinity

intrusion, which can harm both marine and terrestrial species. Deforestation in the canal's watershed has also diminished its natural water retention capacity, worsening the effects of drought. If rainfall patterns continue to decline, the region could face long-term biodiversity loss and further degradation of freshwater resources, undermining the canal's sustainability.

The Panama Canal's water shortages have caused major disruptions in global shipping. To conserve water, the Panama Canal Authority (ACP) reduced daily transits from 36 to 24 ships, leading to lengthy delays and increased costs. Some vessels have been forced to lighten their cargo by up to 40% to meet draft restrictions, reducing efficiency and raising freight rates. Many shipping companies are now rerouting through the Suez Canal or around Africa's Cape of Good Hope, adding 1-2 weeks to transit times and significantly increasing fuel expenses. These delays ripple through supply chains, affecting the transport of LNG, grains, and consumer goods, ultimately driving up prices for end consumers. Without significant infrastructure improvements or climate adaptation measures, the canal's reliability as a global trade route remains at risk.

6.4. Infrastructure

While the canal's operational recovery is underway, risks persist [141].

- **Climate Volatility:** The next El Niño cycle (expected by 2026–2030) could reignite droughts, stressing water reserves. The ACP's reliance on the delayed Rio Indio reservoir project underscores vulnerability to climate shocks.
- **Geopolitical Risks:** U.S. concerns over Chinese influence (e.g., Hutchison Ports' concessions) and ongoing tensions in the Red Sea (e.g., Houthi attacks) could disrupt trade flows.
- **Infrastructure Delays:** Alternatives like Mexico's Interoceanic Corridor (targeted for 2033) and Colombia's Pacific Rail Corridor face logistical hurdles, leaving the Panama Canal as the sole viable route for now.

The Panama Canal's traffic surge in early 2025 reflects a fragile but measurable recovery from its worst drought in a century. Container traffic's dominance and bulk cargo's rebound signal resilience in global trade, while LNG's decline and geopolitical risks highlight vulnerabilities. Investors should prioritize sectors directly tied to the canal's operational efficiency (e.g., container shipping, logistics) while hedging against climate and infrastructure risks. With 25.04% year-on-year growth in transits, the canal remains a linchpin of global trade, but its future hinges on water security, geopolitical stability, and adaptive infrastructure.

7. Policy Pathways and Recommendations: Lessons from the Baltic Sea and Europe

This work set out to demonstrate how Latin America maritime sector holds a strong significance as the region's economies depend heavily on commodity exports such as agricultural products, minerals, and hydrocarbons in the global markets. Yet, despite its potential, Latin America's maritime sector is plagued by inefficiencies, underinvestment, and fragmented regulation mentioned in chapter one. These structural weaknesses have hindered the region's competitiveness in global supply chains and constrained its integration into sustainable maritime transitions. Latin America's maritime sector stands at a crossroads where its current inefficiencies, underinvestment, and fragmented governance threaten to undermine its global trade competitiveness. By contrast, Europe, especially the Baltic Sea Region has demonstrated how effective regulation, innovative financing, and technological adoption can transform maritime sectors into engines of sustainable development. This last chapter will extract lessons in the European and Baltic contexts, and proposes possible policy pathways and recommendations that can enhance port efficiency, green transition, financing, governance, and regional cooperation.

As earlier discussed (Chapter 1), the maritime sector in Latin America faces multi-dimensional challenges that limit its global competitiveness. One of the most pressing issues is infrastructure underdevelopment. Some of the ports in the region are still lacking modern facilities for container handling, energy-efficient operations, and digitalized logistics systems. Unlike the highly automated ports of Northern Europe, Latin American ports continue to struggle with outdated equipment and congested hinterland connections, which slow down trade flows and inflate logistics costs. These inefficiencies often raise freight costs by up to 30% compared to global averages, eroding the region's trade competitiveness [142].

Financing constraints pose a significant barrier not only because the Latin America ports infrastructural development is handicapped but also because the national fleets face chronic underinvestment. While the European Union has advanced financing schemes aligned with the green shipping and activities [143], Latin America on the other hand lacks robust mechanisms to channel funds into sustainable maritime infrastructure and fleet modernization. These issues are linked to environmental sustainability that should target the region's maritime emissions that are significant to the adoption of alternative fuels such as LNG and ammonia [144, 145]. So far, Latin America has made limited progress in exploring viable decarbonization pathways and important in regions like the Caribbean popular for cruise tourism raises concerns about environmental externalities, which are poorly regulated compared to clean cruise initiatives in the Baltic Sea [146].

Institutional capacity and regional cooperation remain weak to yield significant outcome that can improve the current situation in the region. A key strength of the Baltic model is the use of strict

environmental regulation as a driver of innovation. The implementation of SECA rules pushed shipping companies to invest in scrubbers, LNG, and alternative energy solutions [147, 148]. According to Prause & Olaniyi [149], although compliance increased short-term costs, it generated long-term benefits by positioning the region as a leader in clean shipping technologies and environmental governance.

The importance of multilateral frameworks and coordinated policies across countries cannot be downplayed [150]. As long as the Latin America region fails to form a cohesive maritime governance mechanism, with countries pursuing isolated national strategies, there will be an hinderance to the development of integrated corridors and regional energy transition plan. In other words, harmonized regulatory frameworks in the Latin America maritime might be the key to its future vis a vis the current global climate challenge. For example, while the Baltic Sea implemented strict Sulphur Emission Control Area (SECA) rules to curb pollution [151, 152,153,154]. What has been witnessed so far in Latin America's regulatory landscape is a region riddled with fragmented policies, where environmental rules are inconsistently enforced across countries. This lack of coherence creates uncertainty for shipowners and investors, discouraging long-term investments in clean technologies especially as maritime governance often suffers from limited stakeholder engagement, weak enforcement capacity, and gaps in smart regulatory approaches [155].

Targeted policies, technology, and finance can align to create competitive and sustainable maritime systems [143]. The Baltic Sea has been successful in mobilizing financing mechanisms for sustainable maritime investment. European financial institutions, under the EU's Green Deal, created favourable conditions for risk-sharing and target costing analysis that facilitated private sector participation in clean energy and port modernization projects. This type of financing innovations can inspire Latin America to create blended finance tools that de-risk investment in low-carbon shipping and green port infrastructure. Diverse research on clean shipping investments has also demonstrated the value of holistic cost-benefit approaches in evaluating projects i.e. [156]

Therefore, the Latin America must develop sustainable maritime financing frameworks that combine public resources with private capital. The region could establish maritime green bonds, risk-sharing facilities, and concessional finance mechanisms to support investments in LNG bunkering facilities, ammonia production, and waste heat recovery systems (see [157, 158]). By aligning its financing with sustainability objectives, Latin America can overcome its chronic investment deficit and modernize its port and fleet infrastructure.

The Baltic model highlight the importance of regional cooperation. Multilateral frameworks fostered collaboration among governments, shipping companies, and research institutions, creating a coordinated response to environmental and logistical challenges [159].

Transforming Latin America's maritime sector requires a multifaceted policy approach that integrates regulatory reform, financing innovation, technological adoption, and regional cooperation. This

pathway involves strengthening environmental regulation as a catalyst for innovation through smart port initiatives that include automation and renewable energy integration, enhanced efficiency and reduced emissions in bulk cargo handling [160]. Studies have shown that stricter regulations can stimulate innovation and create entrepreneurial opportunities (i.e. [161]).

Such policies would not only improve environmental performance but also enhance the region's competitiveness in global green shipping markets. A South American or Pan-American maritime forum could harmonize regulations, coordinate green corridors, and facilitate collective bargaining for international financing to align sustainability, social cohesion, and security [162, 163]. Innovation ecosystems should be cultivated to encourage entrepreneurship and innovation [148] through partnerships between universities, maritime companies, and governments, ensuring that knowledge transfer drives sustainable maritime development.

The adoption of alternative energy solutions should be prioritized and align directly with the IMO 2050 projections. The role of ammonia, LNG, and waste heat recovery systems as viable pathways for decarbonization. (See [144, 164]). Latin America can leverage its abundant renewable energy potential to produce clean energy and reduce their high dependency on imported fossil fuels. Investment appraisal tools developed by Olaniyi & Prause [165, 166] can guide decision-makers in evaluating the cost-effectiveness of such technologies in Latin American fleets.

It has been proven that the digitalization of maritime supply chains can reduce voyage costs, improve service quality, and foster supply chain resilience [167]. Advancement of port modernization and digitalization is must [19]. Holistic clean shipping assessment tools [157, 168, 169] and cluster-based regional development strategies [170] can help to enhance efficiency.

In summary, by adopting stricter environmental regulations, mobilizing innovative financing, embracing alternative energy, modernizing ports, and strengthening governance structures [171, 172] Latin America can chart a path toward a competitive, resilient, and green maritime future. The region's abundant renewable resources and strategic geographic position provide unique opportunities to leapfrog into sustainable shipping leadership. What is needed is the political will and coordinated action to translate these opportunities into lasting transformation.

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