Role of Ports and Berths in Shaping Trade in Indian Ocean Countries

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Abstract

This study evaluates the strategic importance of ports and berths in the Indian Ocean, assessing their impact on maritime trade and national development indicators such as the Logistic Performance Index (LPI) and Country Policy and Institutional Assessment (CPIA) scores. The research finds a significant positive correlation between the number of ports and berths and trade openness, suggesting that robust port facilities significantly boost a country's trade relative to its GDP. Furthermore, nations with well-developed ports and numerous berths exhibit higher LPI scores, indicating efficient logistics operations. Additionally, a strong link between extensive maritime infrastructure and higher CPIA scores demonstrates the critical synergy between effective maritime facilities and improved policy frameworks. These findings highlight the essential role of maritime infrastructure in enhancing economic development and optimizing logistics and policy environments in the Indian Ocean region.

Keywords: *Indian Ocean, Maritime trade, National development, Logistic Performance Index (LPI), Country Policy and Institutional Assessment (CPIA, Maritime infrastructure, Logistics operations, Policy frameworks*

1. Introduction

The Indian Ocean, the third-largest of the world's oceanic divisions, holds profound significance in both ecological and geopolitical realms (Davis & Balls, 2019). Covering about 20% of the Earth's water surface, it borders Africa, Asia, and Australia, making it a critical maritime route that facilitates international trade, especially for energy resources. This ocean is a vital artery for the global economy, with over 40% of the world's offshore oil production occurring in its waters (Jaishankar, 2016). Furthermore, the Indian Ocean plays a crucial role in global climate regulation. It is a significant driver of the monsoons, impacting agriculture and water resources in populous countries like India and Bangladesh. Thus, the Indian Ocean is central to the socioeconomic stability of its coastal states and critical to global ecological and economic networks.

Ecologically, the Indian Ocean supports an incredible diversity of marine life, including vital species such as tuna, essential for commercial fisheries and the food security of millions in the region (Wafar et al., 20211). Its warm waters are crucial for the health of coral reefs and serve as breeding grounds for various marine species. This ocean plays a crucial role in influencing the climate patterns, including the monsoons, which are crucial to the region's rainfall and agriculture (Zhisheng et al.,

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2015). Rich in biodiversity, the Indian Ocean supports many marine life and ecosystems, from coral reefs teeming with colourful fish to deep-sea trenches inhabited by unique species. It is also a vital route for global maritime trade, carrying a significant portion of maritime traffic.

Populations living near the Indian Ocean span several continents, including Asia, Africa, and Australia, showcasing diverse cultures, languages, and economic activities. South Asia, India, Bangladesh, and Sri Lanka have significant coastal populations engaged in agriculture, fishing, and trade, with major cities like Mumbai, Colombo, and Chittagong serving as economic centres. Southeast Asia sees countries like Indonesia, Thailand, and Malaysia leveraging their extensive coastlines for fishing and domestic trade. East Africa, with countries such as Somalia, Kenya, Tanzania, and Mozambique, relies heavily on maritime resources and coastal tourism, with areas like Zanzibar and Mombasa being key tourist destinations. In the Middle East, nations on the Arabian Peninsula, like Oman and Yemen, utilize their coastlines for strategic shipping and military purposes, and fishing and tourism also play roles. Western Australia's coastal areas, including cities like Perth and Broome, are involved in mining, fishing, and pearl farming. These coastal communities are deeply connected to the Indian Ocean, influencing local economies, climates, and lifestyles.

The Indian Ocean is vital for shipping goods between the eastern and western parts of the world. Major shipping lanes carry diverse commodities, including minerals, textiles, and agricultural products. Strategic ports along the coasts of India, Indonesia, and South Africa, among others, serve as pivotal hubs for this extensive maritime trade network. The ocean's strategic importance is underscored by its role in economic activities and geopolitical strategies, influencing global trade dynamics profoundly.

Given the pivotal role of the Indian Ocean in shaping trade dynamics and maritime infrastructure, this study seeks to comprehensively examine the influence of ports and berths on these elements. Initially, the study analyzes how the existence and efficiency of ports and berths contribute to trade openness. This involves assessing the extent to which these facilities enhance the capacity of countries bordering the Indian Ocean to engage in international trade. Subsequently, the research investigates the role of ports and berths in shaping the Logistic Performance Index, a benchmarking tool created by the World Bank to help countries identify challenges and opportunities in their logistics sectors. Lastly, the study investigates how ports and berths impact countries' Country Policy and Institutional Assessment (CPIA) scores within the Indian Ocean rim.

2. Ports and berth of Indian Ocean countries

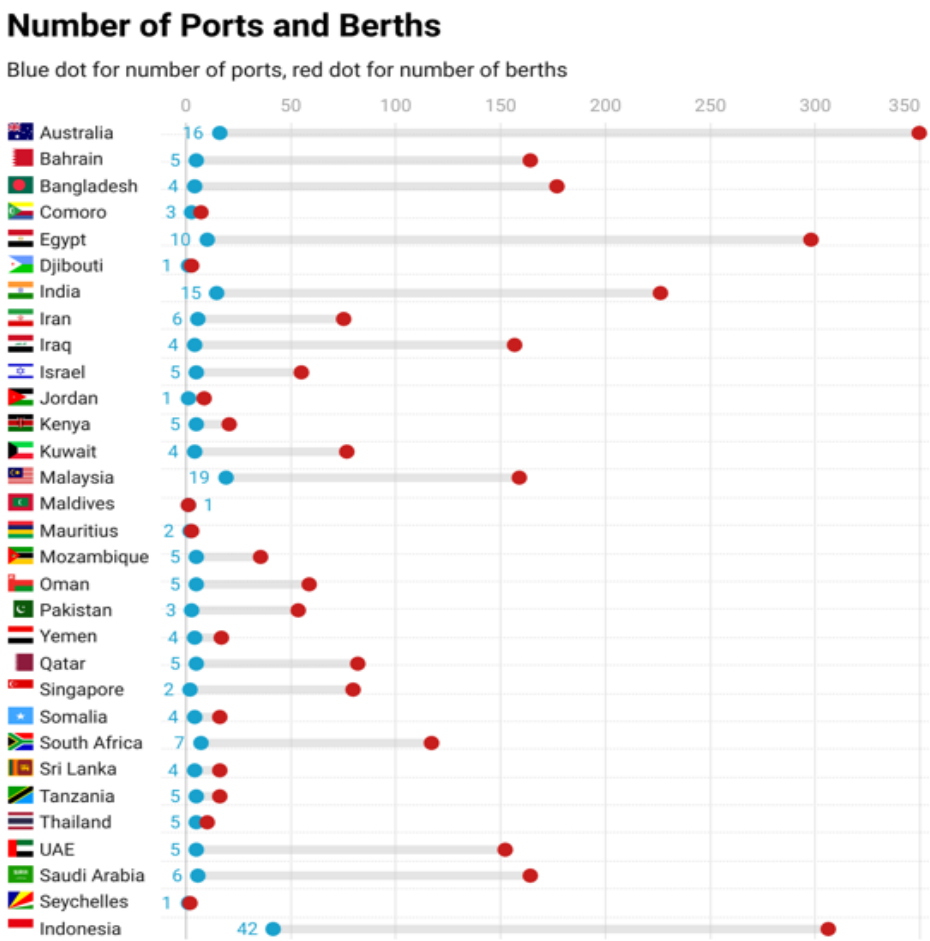
Ports and berths are crucial in the global economy, serving as the primary nodes in international trade and logistics. As gateways for the movement of goods and passengers, ports facilitate the efficient transfer of commodities between sea and land transport modes, driving economic growth and development (Notteboom, 2013).

Berths, as specialized locations within ports, are essential for accommodating ships, enabling the loading and unloading of cargo and boarding passengers. Efficient port operations and well-managed berths ensure reduced vessel turnaround times, lowering shipping costs and enhancing supply chain reliability (Munzaa, 2022). Moreover, modern ports equipped with advanced berths support handling vast quantities of cargo, including bulk, containerized, and break-bulk goods, which is vital for industries and economies worldwide (Vigarié, 1999). Thus, the strategic development and maintenance of ports and berths are integral to sustaining global commerce and economic stability.

In light of the significant role ports and berths play, we have illustrated in Figure 1 the distribution of ports and berths in countries situated along the Indian Ocean. This visualization provides a comparative analysis of maritime infrastructure capabilities across these nations, reflecting both their economic engagement and logistical capacities. Countries like Malaysia demonstrate extensive facilities with a considerable discrepancy between ports and berths, indicating highly developed maritime infrastructure. Countries like Malaysia stand out with many ports (19) but also exhibit a disproportionately more significant number of berths (around 300), indicating extensive facilities per port. Similarly, Australia has fewer ports (16) and has a very high berth count, suggesting large, well-equipped ports. In contrast, some countries like Comoros and Maldives show minimal ports and berths, aligning with their more minor geographic and economic scales. This analysis underscores how nations allocate resources to develop maritime infrastructures based on their economic priorities and geographical necessities.

The graph showcases distinct maritime infrastructure strategies between countries with high-capacity ports and those with widespread but lower-capacity ports. Australia, Malaysia, and Singapore exemplify nations that have concentrated on developing a smaller number of ports, each equipped with a substantial number of berths Australia with 350 berths across 16 ports, Malaysia with around 300 berths across 19 ports, and Singapore with nearly 150 berths for just two ports. This setup supports heavy maritime traffic and large-scale operations efficiently. Conversely, countries like India, Iran, Kuwait, Mauritius, Mozambique, Oman, Pakistan, and Yemen have a relatively higher number of ports but fewer berths per port. For example, India has 15 ports but only just over 150 berths, indicating a strategy of distribution and accessibility overcapacity, which may reflect a focus on regional connectivity rather than high-volume international trade.

Figure 1: *Distribution of Ports and Berths Across the Countries*



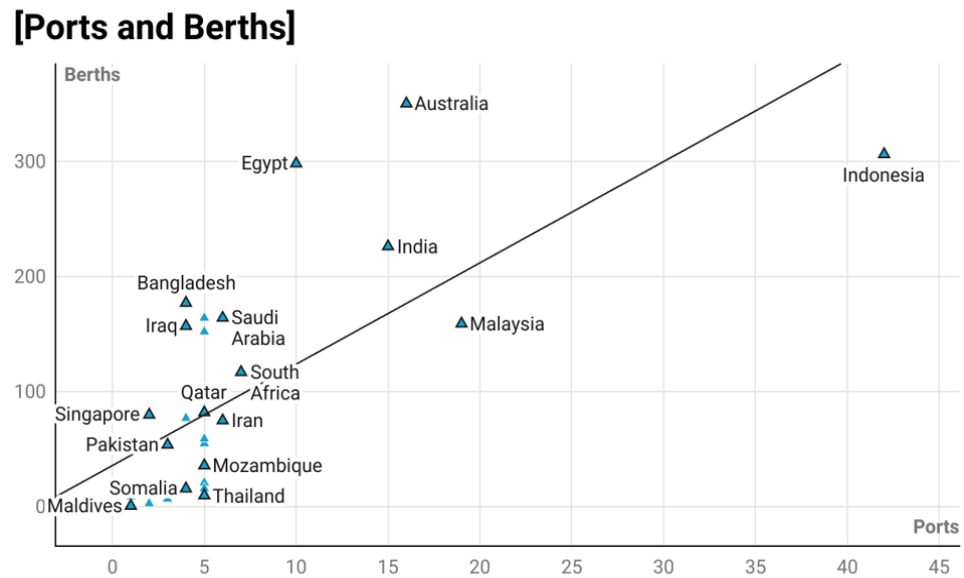
Source: Author's own construction of the figure by utilizing data derived from Maritime Data

2.1 Association of ports and berths

The association between the number of ports and the number of berths, as illustrated in Figure 2, in the form of scatter plot generally indicates a positive correlation: as the number of ports increases, the number of berths also tends to increase. This trend suggests that countries with more ports also tend to have greater overall berthing capacity, which is logical since more ports can accommodate more vessels, requiring more berths. Countries like Indonesia and Australia stand out; Indonesia has the highest number of ports (around 42) but fewer berths compared to Australia, which, despite having fewer ports (16), boasts significantly more berths

(around 350). This indicates that Australia's ports are larger and possibly more equipped than those in Indonesia. Countries like Singapore and Qatar show fewer ports with a moderate number of berths, reflecting efficient use of limited space. Conversely, countries such as Pakistan, Somalia, and the Maldives have low counts of both ports and berths, highlighting smaller maritime operations.

Figure 2: *Plot of Ports and Berths*



Source: Author's own construction of the figure by utilizing data derived from Maritime Data

3. Measurement of key indicators of trade facilitation

3.1 Trade openness

Trade openness is a measure of a country's economic integration with the global market, gauged by the extent to which it exchanges goods and services with the rest of the world relative to its domestic economic activity (Squalli & Wilson, 2011). This concept is quantified through several critical indicators, the most common of which is the ratio of a country's total trade (sum of exports and imports) to its Gross Domestic Product (GDP) (Arribas et al., 2009). A higher ratio indicates greater openness and suggests that the country is more involved in international trade networks.

Other metrics for measuring trade openness include trade intensity and trade penetration. Trade intensity compares the trade volume of a country with its potential trading partners, providing insights into how actively a country trades given its

opportunities (Huchet-Bourdon et al., 2018). On the other hand, trade penetration looks at imports relative to domestic consumption, indicating how much of the domestic market is served by foreign products. These measurements help policymakers and economists assess the impact of trade policies and the degree to which an economy is globally interconnected.

3.2 Logistic performance index (LPI)

The Logistic Performance Index (LPI) is an interactive benchmarking tool developed by the World Bank to help countries identify the challenges and opportunities they face in their performance on trade logistics (Minnow et al., 2022). It is part of a broader initiative to stimulate logistics performance worldwide. The LPI is based on a worldwide survey of logistics professionals who are asked to rate the logistics performance of the countries they are familiar with based on their experiences in moving goods and freight.

The LPI assesses countries across six key dimensions as outlined by Ojala and Celebi (2015):

- **Efficiency of customs and border management clearance** (the speed, simplicity, and predictability of formalities by border control agencies, including customs).
- **Quality of trade and transport infrastructure** (quality of port, rail, roads, and information technology).
- **Ease of arranging competitively priced shipments** (ease of arranging competitively priced international shipments).
- **Competence and quality of logistics services** (competence of the local logistics industry, including transport operators and customs brokers).
- **Ability to track and trace consignments** (ability to track and trace consignments through the supply chain).
- **Timeliness of shipments in reaching the destination** (frequency with which shipments reach the consignee within the scheduled or expected delivery time).

The aggregate of these six detailed components yields an overall LPI score for each country, which reflects its logistics performance on a scale from 1 (lowest) to 5 (highest) (Martí et al., 2017). The LPI thus provides valuable insights into the logistics environment of a country, which can be crucial for enhancing economic competitiveness and improving trade flows.

3.3 Country Policy and Institutional Assessment (CPIA)

The Country Policy and Institutional Assessment (CPIA) is a diagnostic tool developed by the World Bank (Van Waeyenberge, 2009). It assesses the quality of a country's policies and institutional frameworks and how effectively these support sustainable growth, poverty reduction, and the effective use of development

assistance? The CPIA plays a significant role in determining the financial support that low-income countries receive from the World Bank's International Development Association (IDA), one of the most important sources of assistance for the world's poorest nations.

The CPIA evaluates countries based on a set of 16 criteria grouped into four clusters as outlined by World Bank (2021):

- **Economic Management**: This includes monetary and fiscal policy and trade policies.
- **Structural Policies**: Assessed areas include policies for social inclusion/equity (such as gender equality), public sector management, and the environment.
- **Policies for Social Inclusion/Equity**: Focuses on equity, social protection, and labour.
- **Public Sector Management and Institutions**: Evaluate the quality of public administration and the transparency of the government.

Each criterion is rated on a scale from 1 to 6, where 6 represents the best performance. These scores are used to allocate financial resources and foster dialogues between the World Bank, its member countries, and other stakeholders about improving a country's policies and institutions to better support development goals better.

4. Trade Openness with ports and berths

The scatter plot in Figure 3a displays the relationship between the number of ports in a country and trade as a percentage of its GDP. The trend line indicates a positive correlation, suggesting that countries with more ports tend to have a higher proportion of trade relative to their GDP. This relationship underscores the role of maritime infrastructure in supporting and facilitating trade activities. For instance, countries like Egypt, which shows the highest number of ports, also exhibit a substantial trade percentage of GDP, highlighting the effectiveness of multiple ports in boosting economic activities through trade. In contrast, countries with fewer ports, such as Comoros and Pakistan, show lower trade percentages, suggesting limited trade activity relative to their economies. This visualization illustrates how increased port facilities can enhance a country's trade capacity and economic integration into global markets.

The scatter plot in Figure 3b shows the relationship between a country's trade as a percentage of GDP and its number of berths. Generally, the trend line indicates a positive correlation: as the number of berths increases, the trade percentage of GDP also tends to increase. This suggests that countries with more extensive port facilities, capable of handling a larger volume of maritime traffic, typically engage more in trade relative to their GDP. More berths improve a port's ability to handle ships, lowering congestion and turnaround time (Slack et al., 2018). This improves trade efficiency, attracts more maritime traffic, and reduces logistical costs, increasing a country's

competitiveness in global markets (Clark et al., 2004). As a result, trade volumes are larger compared to GDP, which explains the positive association. For instance, countries like Australia, Indonesia, and Egypt, which have many berths, show substantial trade activity, aligning with the notion that robust maritime infrastructure supports greater economic activity through trade. Conversely, countries with fewer berths, such as Pakistan, Tanzania, and Comoros, have a lower trade percentage of GDP, indicating lesser engagement in trade activities. This plot highlights the significant role of maritime infrastructure in facilitating and expanding international trade.

The positive correlation between the trade percentage of GDP and the number of ports and berths is driven by several factors. More ports and berths increase a country's capacity to handle sizeable maritime trade volumes, directly boosting the trade volume relative to GDP. Efficient port operations enhance connectivity with international markets, reduce logistical costs, and make trade more viable, thereby increasing economic activities (Clark et al., 2004). Ports stimulate economic development by supporting related industries like shipping and manufacturing, which benefit from direct market access. Additionally, well-developed ports attract foreign investment and offer competitive advantages in global trade, actively increasing participation in international supply chains and raising the trade percentage of GDP (de Langen, 2020).

Figure 3a: *Plot of Trade Openness and Ports*

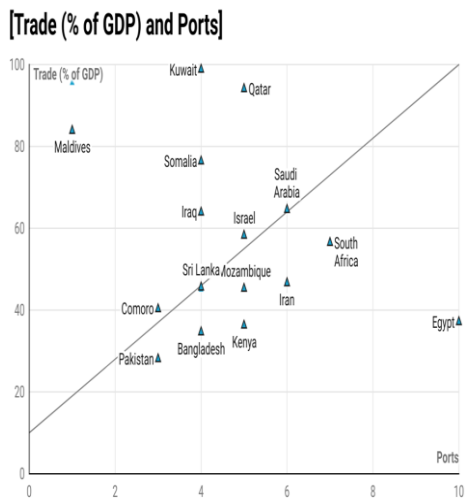
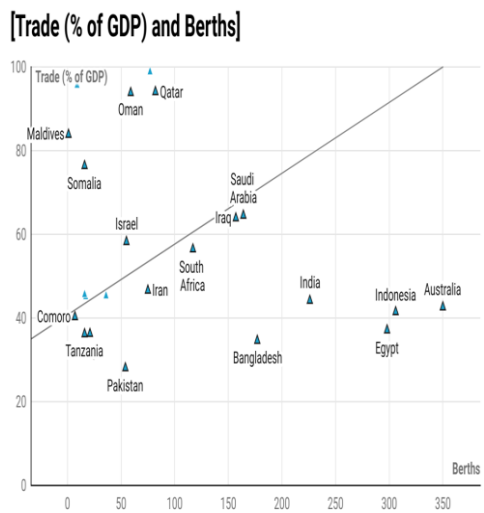


Figure 3b: *Plot of Trade Openness and Berths*



5. LPI with ports and berths

The scatter plot illustrates the relationship between the Logistics Performance Index (LPI) and the number of ports in various countries (see Figure 4a). The trend

line indicates a positive correlation, suggesting that higher numbers of ports are associated with better logistics performance. More ports provide redundancy, robustness, and routing possibilities by acting as extra nodes in a nation's commerce network (Asadabadi & Miller-Hooks, 2020). This facilitates adaptable logistics solutions, decentralizes cargo flow, and lessens reliance on single-entry points—all of which are crucial in times of disruption (such as pandemics or geopolitical conflicts). By connecting port quantity with better logistics performance in a dynamic trade environment, this systemic flexibility and increased capacity immediately raise a nation's LPI score (Sharawi et al., 2025).

The LPI measures how efficiently countries move goods and manage logistics, including customs, infrastructure, international shipments, logistics quality, tracking, and timeliness. Countries like Singapore and UAE, known for their efficient logistics and high LPI scores, have a moderate number of ports, emphasizing quality over quantity. Meanwhile, Indonesia has the highest number of ports, which correlates with a relatively high LPI, showing that extensive port facilities can contribute to effective logistics. However, countries like Yemen and Somalia, with fewer ports, register lower LPI scores, indicating challenges in logistics efficiency. This graph highlights the significant impact of well-developed port infrastructure on a nation's overall logistics performance.

The scatter plot presents the relationship between the Logistics Performance Index (LPI) and the number of berths in various countries (see Figure 4b). The trend line shows a positive correlation, suggesting that countries with more berths tend to have higher LPI scores. The LPI assesses countries based on factors such as customs efficiency, logistics quality and competence, infrastructure quality, ease of arranging shipments, tracking of shipments, and timeliness (La & Song, 2019). Countries like Australia, UAE, and Singapore, which feature high LPI scores and a substantial number of berths, underscore the importance of robust port infrastructure in enhancing overall logistics performance. Conversely, countries such as Yemen and Somalia, with fewer berths, have lower LPI scores, indicating challenges in logistics services and infrastructure. This data highlights how extensive berth facilities can significantly bolster a country's logistics capabilities, facilitating smoother and more efficient trade and transportation processes.

A positive correlation between the LPI and the number of ports and berths stems from several factors: enhanced infrastructure quality ensures efficient cargo handling and smoother transitions, reducing congestion (Sharapiyeva et al., 2019). More ports improve service efficiency by decreasing waiting times and providing more shipping options, boosting sub-categories like timeliness and shipment reliability in the LPI. Additionally, increased international connectivity from more ports facilitates trade, and technologically advanced ports improve customs and tracking processes, elevating LPI scores (Hasan et al., 2025). Thus, robust port facilities are crucial for improving a country's logistics performance.

Figure 4a: *Plot of LPI and Ports*

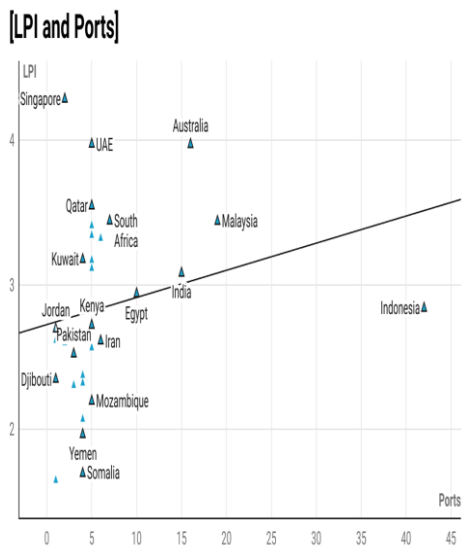
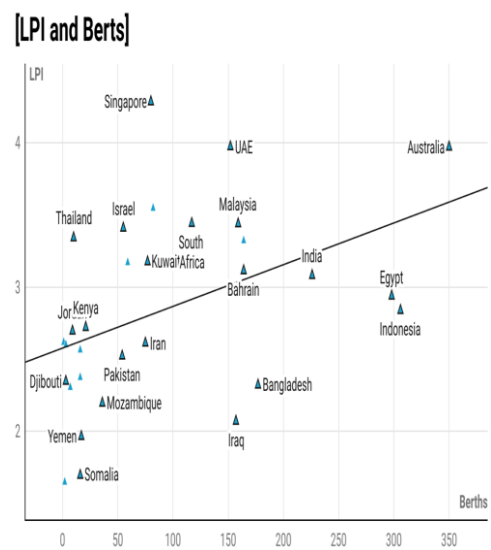


Figure 4b: *Plot of LPI and Berths*



6. CPIA with ports and berths

The scatter plot displays the relationship between the Country Policy and Institutional Assessment (CPIA) score and the number of ports in various countries (see Figure 5a). The CPIA evaluates the quality of a country's policy and institutional framework, influencing developmental outcomes. The trend line indicates a generally positive correlation, suggesting that as the number of ports increases, the CPIA score tends to improve. A greater number of ports indicates a government's dedication to public investment, efficient regulation, and trade facilitation (Ng & Gujar, 2009). Better governance practices and policy reforms two important elements impacting CPIA scores are prompted by this evident infrastructure expansion, which also increases donor and investor trust (Riegner, 2016). Ports serve as significant markers of institutional development and policy credibility in addition to being sites for trade. Countries like India, with a higher number of ports (around 15), show a relatively high CPIA score, reflecting strong policy and institutional quality possibly supported by robust maritime infrastructure. Conversely, with fewer ports, Somalia exhibits a lower CPIA score, indicating challenges in policy and institutional effectiveness. This plot illustrates that countries with more developed port facilities may have better policy environments, likely due to more extensive maritime trade infrastructure's economic advantages, and administrative capacities.

The scatter plot in Figure 5b illustrates the relationship between the Country Policy and Institutional Assessment (CPIA) score and the number of berths in various countries. The trend line suggests a positive correlation, indicating that countries with more berths tend to have higher CPIA scores. For instance, India and Bangladesh,

with substantial numbers of berths, display relatively high CPIA scores, suggesting that well-developed maritime infrastructure may contribute to stronger policy and institutional frameworks, likely due to the economic and administrative benefits derived from active maritime trade. In contrast, with the fewest berths, Somalia shows a lower CPIA score, highlighting potential deficiencies in policy and institutional quality. This plot underscores the potential link between robust port facilities and enhanced policy environments, which can drive more effective development outcomes.

The positive correlation between the Country Policy and Institutional Assessment (CPIA) scores and the number of ports and berths is due to the synergy between robust policy frameworks and adequate maritime infrastructure. Ports and berths are vital for facilitating international trade and economic integration, enhancing a country's economic activities. Effective policies supporting the development of these facilities contribute to higher CPIA scores. Moreover, higher CPIA scores attract international investments, further developing port infrastructure, creating a cycle of economic improvement and policy strength (Song & van Geenhuizen, 2014). Efficient management of these facilities also mirrors the broader administrative competence, essential for high CPIA ratings, demonstrating a country's commitment to using its maritime assets for economic and institutional advancement.

Figure 5a: *Plot of CPIA and Ports*

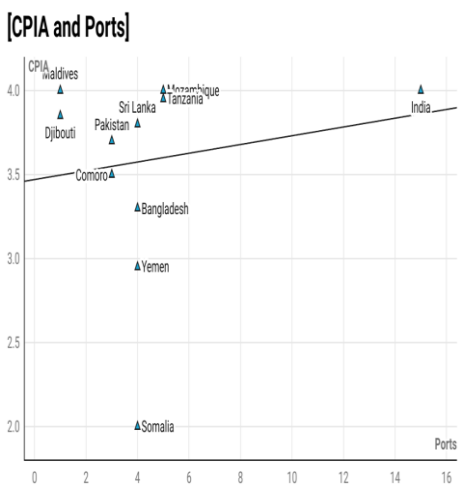
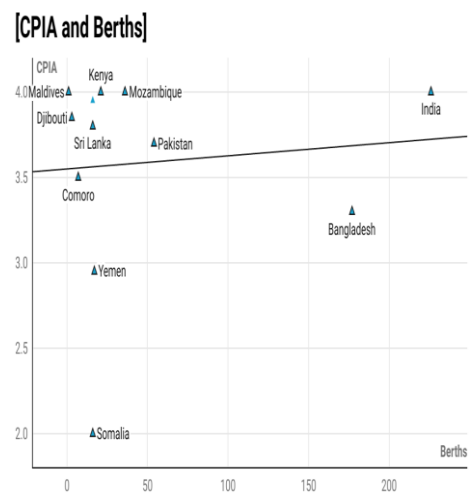


Figure 5b: *Plot of CPIA and Berths*



7. Conclusion

The analysis of ports and berths across the Indian Ocean region reveals a significant relationship between maritime infrastructure, trade openness, Logistic Performance Index (LPI), and Country Policy and Institutional Assessment (CPIA) scores. Countries with a higher number of ports and berths tend to demonstrate greater

economic integration and better logistic capabilities, which in turn contribute to higher national performance in policy and institutional assessments. Numerous ports and extensive berthing facilities enhance a country's capacity to handle large volumes of international maritime traffic, thereby increasing its trade relative to GDP. This capability facilitates economic growth by providing seamless connections between sea and land transport, reducing transportation costs, and improving supply chain reliability. Nations like Australia and Malaysia, with well-developed ports and numerous berths, are prime examples of how robust maritime infrastructure can support high-volume international trade and economic activities.

Moreover, a positive correlation between the number of berths and the Logistic Performance Index indicates that extensive port facilities are crucial for efficient logistics. Ports with ample berthing options can manage cargo more effectively, ensuring faster loading and unloading and enhancing overall logistical performance. This efficiency is crucial for improving a country's competitiveness by minimizing delays and maximizing the reliability of supply chains. Furthermore, a noticeable link between maritime infrastructure and CPIA scores reflects the quality of a country's policies and institutional frameworks. Enhanced port facilities contribute to better economic management and structural policies, essential for sustainable development and effective use of international aid. Thus, countries with robust port infrastructures tend to have stronger institutional frameworks, as demonstrated by their higher CPIA scores.

In conclusion, the number of ports and berths plays a crucial role in shaping a country's trade capabilities, logistic performance, and policy and institutional quality. Strengthening maritime infrastructure boosts economic activity and trade efficiency and enhances the overall governance and policy environment, promoting sustainable development and international cooperation.

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