JOURNAL OF MARITIME RESEARCH

Vol XXII. No. III (2025) pp 153–158

ISSN: 1697-4840, www.jmr.unican.es

Maritime Logistics Index (MLI): A composite Index

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ARTICLE INFO

Article history:
Received 28 Dec 2024;
in revised from 24 Jan 2025;
accepted 25 Mar 2025.

Keywords:
Logistics, Maritime Transport, Composite Index, Covid Pandemic, Port System.

ABSTRACT

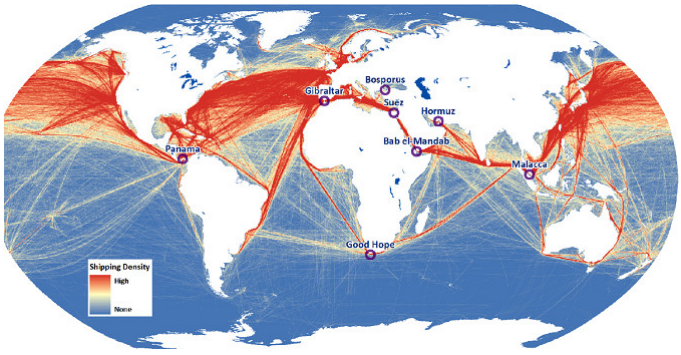
Many indicators have been developed over the years to measure the quality of logistics, but it is not easy to capture the essence of the whole maritime system. To partially bridge this gap, a new index called Maritime Logistics Index (MLI) is proposed. This index captures the information related to the maritime system, such as maritime connectivity, port throughput, logistic performance and gross domestic product. It is widely accepted that the access to the global markets depends largely on all these facets, which are now bring together to measure the strength of maritime logistics at a country level. Additionally, the paper brings a brief discussion about the consequences of covid-19 pandemic and reveals the best performing countries after the crisis, in terms of maritime logistics.

1. Introduction.

Maritime logistics is a direct contributor to production and consumption activities and is of critical importance for social and economic development (Avni et al., 2018). Today, maritime transport connects ports, countries and markets, facilitating container trade on a scale never seen before (Figure 1). In addition, the associated logistics chains are a source of employment worldwide and play a crucial role in the globalization process. It is not only crucial in contributing to the economic development of countries, but also contributes significantly to their stability and security.

To better understand the logistics environment of countries, it is first necessary to ask local experts. Usually, valuable information is obtained from interviews with leading logistic entrepreneurs, academic researchers, and policy makers, see for example Tansakul et al. (2018). Additionally, knowledge can be obtained through annual reports of multinational corporations, see Göpfert et al. (2016). In this sense, some international organizations and research centers develop annually composite indexes to understand logistics at a country level. These measurable indexes are the bedrock of this study, which aims to bridge the existing gap amongst the indexes related to economy and maritime transport.

Figure 1: Maritime logistics index (MLI: 2010-2020).



Source: Rodrigue J.P. (2020).

The paper has two goals. The first one is to develop a composite index for measuring logistics worldwide. This index namely Maritime Logistics Index (MLI) should use the existing information related to the economy, overall logistics performance, maritime connectivity, port throughput, etc. of countries. The second goal is to analyze the covid-19 pandemic and

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its effect on the logistics of countries from the perspective of the new index. To that end, two scenarios should be studied, one representing the precovid year and the other representing the situation after the pandemic disease.

The article is organized as follows; a literature review is included in Section 2. Then the specific components of the new index are proposed in Section 3. The methodology to build the new index and the main results are presented in Sections 4 and 5 respectively. And finally, conclusions are presented in Section 6.

2. Literature review.

The improvement of ports and maritime services has become an essential driver for the economic growth of countries. In this sense, a well-defined logistic environment leads to cost savings and hence competitiveness of the country, see Digiesi et al. (2016). Several complex indicators have been developed over the years to measure economic variables and competitiveness of logistic systems. A performance index refers according to OECD (2008) to a composite indicator, which is formed when individual indicators are compiled into a single index on the basis of an underlying model. The composite index should ideally measure multi-dimensional concepts which cannot be captured by a single indicator, e.g., competitiveness, industrialisation, sustainability, single market integration, knowledge-based society, etc. In total more than a dozen indicators of trade facilitation have been developed testifying the importance of the subject as well as its complexity, (Auboin et al. 2015). Some of these composite indicators are summarized in Table 1.

Table 1: Country level indicators.

Index	Source
Liner Shipping Connectivity Index (LSCI)	UNCTAD
Liner Shipping Bilateral Connectivity Index (LSBCI)	UNCTAD
Logistics performance index (LPI)	World Bank
Gross Domestic Product (GDP)	World Bank
Quality of port infrastructure (WEF)	World Economic Forum
Enabling Trade Index (ETI)	World Economic Forum
Trade Facilitation Indicators (TFI).	OECD
Container Terminal Quality System (CTQS)	Global Institute of Logistics
Global Connectedness Index (GCI)	DHL
Number of ship calls and other variables	Lloyd's List Intelligence

Source: Author.

It is important to note that not all the previous indicators are developed structurally and made publicly available. There are also cases of public entities like OECD that include benchmark of port performance indicators, but the database behind these indicators is not publicly available, see Ducruet et al. (2014) and Langen (2016). In general, when the data is made publicly available, such as the case of LSCI of unctad, researchers may use it as a primary source to analyse specific maritime networks, from a regional or global perspectives, see the case of LSBCI (Ansorena, 2018) or port throughputs (Ansorena, 2023). This is more difficult when data is not open or there is not a public organization behind the report, see for example the case of DHL (Ghemawhat and Altman 2014).

In regard to performance it is also important to remark that the logistics factor affects not only the competitiveness of a nation, but also the competitiveness of its firms. Poor performance is a barrier to maritime trade and foreign direct investment and thus to economic growth, see Jhawar et al. (2017). In this sense, covid pandemic made a huge impact on the logistics chains all over the world and the response of countries was different. The main reason behind that impact was the reproductive number – the number of secondary infections generated from one infected individual – of the disease. According to the World Health Organization (WHO, 2000), this number was estimated to be between 2.0 and 2.5 for COVID-19 virus, higher than for seasonal influenza whose reproductive number typically ranges from 1.3 to 1.80.

Although the Covid crisis clearly marks a "before" and "after" in logistics worldwide, in the past couple of decades, a plethora of catastrophic natural and manmade disasters have resulted in millions of deaths and billions of dollars of economic loss (Adnan et al. 2022). In the case of COVID-19 pandemic, many countries had severely faced difficulty in operating routine business and supply chain activities. Operational challenges included liquidity crunch, delay, or halts in production activities due to long time shutdown of production sites, resizing the labour workforce, non-availability of raw material, and low demand. These issues brought many companies into a critical situation towards the right balance between survivability and sustainability, from a long-term perspective (Joshi and Sharma, 2022). More recently, Min (2023) has made one of the first attempts to propose crisis management strategies for enhancing supply chain resilience in the aftermath of the COVID-19 pandemic using a strategy map. Given a dearth of this line of research, Min (2023) developed a conceptual framework of crisis management in business-friendly terms. The question now is: how can we measure the logistic strength of countries to deal with pandemic problems?

It is clear that transparency and availability of data are crucial factors to make logistics work. In the case of supply chains, transparency have slowly gained prominence because of its utility in resolving sustainability concerns and improving operational efficiency and decision making (Chatterjee and Chatterjee, 2022). In this sense, identifying the quality of the logistics system from the international perspective is a basic step to eliminate barriers and mitigate the impacts of natural or manmade catastrophic disasters.

In sum, the literature review has presented a brief background on logistics indicators at a country level and the impact of covid on logistic systems. With this general picture in mind we propose a new Maritime Logistics Index (MLI) to monitor the quality of the maritime system from the global perspective. The composite index is computed using four recognized indicators, which are published annually by the United Nations Conference on Trade and Development (UNCTAD) and the World Bank. On one hand, Liner Shipping Connectivity Index (LSCI) and Port Throughput (PT) of countries will be collected from UNCTAD. On the other hand, Gross Domestic Product (GDP)

per capita and Logistics Performance Index (LPI) will be collected from the World Bank. The following section briefly describes the main characteristics of the selected components.

3. Components of the Maritime Logistics Index.

The access to the world market depends largely on the maritime connectivity of countries. The maritime connectivity is provided through liner shipping services which transport goods by means of containerships that transit regular routes on fixed schedules. Within this context, the LSCI developed by UNCTAD aims to capture the level of integration of countries into the global liner shipping network. It measures annually the competitiveness of nations with respect to logistics and transport and is generated from five components (Hoffmann 2005):

- The number of ships.
- The total container-carrying capacity of those ships.
- The maximum vessel size.
- The number of services.
- The number of companies that deploy regular services from/to a specific country.

The LSCI is focus on shipping capacity but ideally it is more interesting to reflect the actual number of containers carried. Unfortunately, data at this level of detail is not easily available (Bartholdi et al. 2016). In addition, the LSCI does not look to the ports of the country (infrastructure, quality of service, turnaround times, etc), although it considers the level of competition on services that connect ports in country A to ports in country B. To bridge this gap we have considered a second component, the Port Throughput (PT). This measure of port competiveness reflects the crucial role that ports play in the configuration of maritime networks. The third component of the composite index is the LPI, which is based on a worldwide survey of operators on the ground that provides feedback on the logistics "friendliness" of the countries; see Arvis et al. (2007) and Arvis et al. (2012). Thus, LPI ranks countries on the following six dimensions of maritime trade:

- The efficiency of customs and border management clearance.
- The quality of trade and transport infrastructure.
- The ease of arranging competitively priced shipments.
- The competence and quality of logistics services-trucking, forwarding, and customs brokerage.
- The ability to trace consignments.
- The frequency with which shipments reach consignees within scheduled or expected delivery times.

It is important to note that the LPI is focus on several aspects of maritime logistics, but it does not bother about the forces behind them. To partially bridge this gap we have included the port throughput (PT) and the Gross Domestic Product (GDP) as the third and fourth components of the new index. On one hand, PT is the most visible variable to describe port function. On the other hand, GDP is an important driver for the logistics chains, since it represents the sum of value added of all producers in each country. The World Bank provides GDP data in current U.S. dollars, although dollar figures for GDP can be converted from domestic currencies using single year official exchange rates. Finally, the links to the primary information sources are:

- LPI: Logistics Performance Index. Data from the World Bank national accounts data, and OECD National Accounts data files. https://lpi.worldbank.org/report.
- GDP: Gross Domestic Product per capita (current US$). Data from the World Bank national accounts data, and OECD National Accounts data files https://data.worldbank-.org/indicator/NY.GDP.PCAP.CD.
- LSCI: Liner Shipping Connectivity Index. UNCTAD, United Nations Conference on Trade and Development. Data from: http://unctadstat.unctad.org.
- PT: Port Throughput of the country (Annual container traffic in TEU). UNCTAD, United Nations Conference on Trade and Development. Data from: http://unctadstat.-unctad.org.

4. Methodology.

In total, three scenarios are analysed: Past decade (2015), Precovid (2019) and Post covid (2022). After the collection of data, the index is generated as follows: For each of the four components (LPI, LSCI, GDP and PT), a country's normalized value is computed. To that end we use:

$$Z_i = \frac{x_i - \min(x)}{\max(x) - \min(x)} \tag{1}$$

where:

"x_i" is the measured value of the component in i^{th} country.

"min (x)" is the minimum measured value of the component $x=(x_1,...,x_n)$.

"max (x)" is the maximum measured value of the component $x=(x_1,...,x_n)$.

"Z_i" is the normalized value of the component in i^{th} country.

Then MLI for country "i" is computed as the average of the four normalized values:

$$MLI_i = \frac{\sum_{j=1}^{4} Z_{i_j}}{4} \tag{2}$$

To better understand how the MLI value is computed we now present as example the case of Spain in the precovid scenario (year 2019).

First we normalize the LPI value of Spain (i^{th} country=139):

"x_i" is the measured value x_{139} = 3.83 (LPI Spain)

"min (x)" is the minimum measured value of x=(x_1,...,x_n): Minimum value of LPI = 2.04

"max (x)" is the maximum measured value of x=(x_1,...,x_n): Maximum value of LPI = 4.20

"Zi" is the normalized value of the i^{th} country. Z_{139}:

$$Z_i = \frac{x_i - \min(x)}{\max(x) - \min(x)} = \frac{3.83 - 2.04}{4.20 - 2.04} \approx 0.828$$

Then the same procedure is applied to the other variables (LSCI, GDP/capita and PT), see Table 2:

Table 2: Calculation of Spanish MLI (i^{th} country=139).

Country: Spain	LPI	LSCI	GDP/capita	PT
Value	3.83	83.91	29,581	17,464,920
Normalized value	0.828	0.544	0.251	0.073

Source: Author.

And finally MLI is computed as the average of the four normalized components:

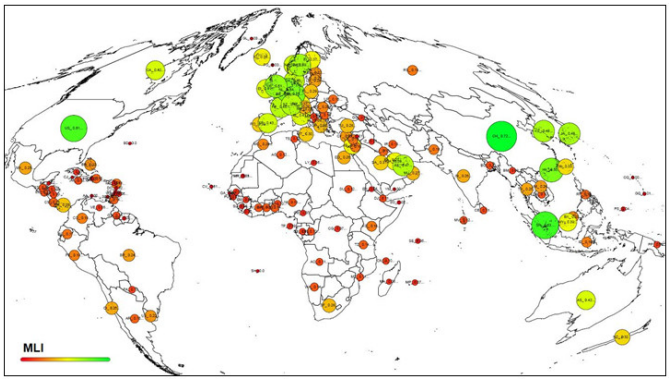
$$MLI_{139} = \frac{\sum_{j=1}^{4} Z_{139_j}}{4} = 0.424$$

This procedure is applied to all the countries in order to reflect the past decade (using data of the year 2015) and the two other scenarios: precovid (year - 2019) and post covid (year - 2022).

5. Results and Discussion.

The experiment data-file, with the detailed calculations to aggregate the components into the MLI, was uploaded to the Mendeley repository (DOI: 10.17632/8gx3rb5dc3.1). Since the dataset includes some missing data it was not possible to compute the exact values for all the countries. However, a general and detailed picture of MLI for the past decade was obtained, see Figure 2.

Figure 2: Maritime logistics index (MLI: 2010-2020).

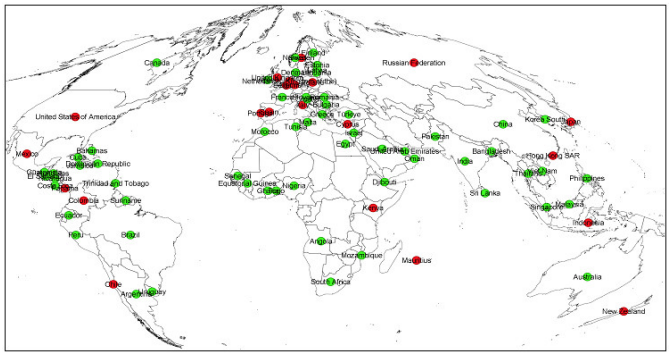


Source: Author.

The above figure represents the situation of logistics in the middle of the last decade. Here a bigger node means a higher MLI value which ranges from 0.0 (theoretical minimum value) to 0.72 (theoretical maximum value in China) In broad terms, high values of MLI (MLI > 0.290) are strongly correlated to a GDP per capita over 25,000 US$, a total port-throughput over 6-7 million containers (TEU size) and a high profile country in terms of UNCTAD and World Bank indicators (LSCI > 3.812 and LPI > 3.43). On the other, hand, low values of MLI (MLI ≤ 0.290) are strongly correlated to a GDP per capita between 10,000 and 25,000 US$, and low levels of LSCI and LPI. Figure 2 proves that MLI is able to measure the quality of maritime logistics in countries all around the globe.

In the second step, the same procedure is developed to understand the effects of covid disease on maritime systems. A pre-covid scenario with data of the year 2019 and a post covid scenario with data of the year 2022 were designed. Following the same methodology the normalization of MLI for both scenarios shows how the maritime systems (economy, logistics, ports and connectivity) evolved all over the world. In this regard, Figure 3 clearly shows the countries that have improved their MLI after the pandemic (in green) and the countries that had not yet recovered their pre-pandemic MLI value by the end of 2022 (in red). It is beyond the scope of this article to discuss what causes one country to perform better or worse than another. Generally speaking, a larger difference between the post-pandemic and pre- pandemic MLI means greater country resilience of its logistic systems.

Figure 3: Countries performance after covid pandemia.



Source: Author.

The MLI scores of each country, as well as their components are included in the Appendix, (also available at www.mendeley.com

Conclusions.

Traditionally, research centers and trade organizations have developed country-level indicators to measure the quality of transport, trade and logistics. These indicators are usually based only on a single facet of the logistics system, instead of multiple facets. For example, the International LPI provides the qualitative evaluation of countries from the perspective of logistics and trading partners. These evaluations are mainly based on surveys from industry leaders' opinions, which are a subjective opinion after all. LSCI measures facts and indicates the integration level of countries into the global liner shipping network. It

definitively adds value to the LPI measure, but there are several crucial characteristics with strong ties to ports and logistics that are not considered by LSCI, nor LPI, e.g., port throughput, hinterland's economy, etc. To partially bridge this gap PT and GDP are added as components of the MLI. The proposed new index captures the overall structure of logistic services (maritime services as well as on-land services) and is able to rank nations according to the strength and reliability of their logistic systems. MLI is relevant in terms of its components: PT, LSCI, LPI and GDP and it is also an accurate measure since the basic data is annually provided by recognized International Organizations. Since the components of MLI are publicly available, the new index has an easy implementation and a high potential to properly rank countries all over the world.

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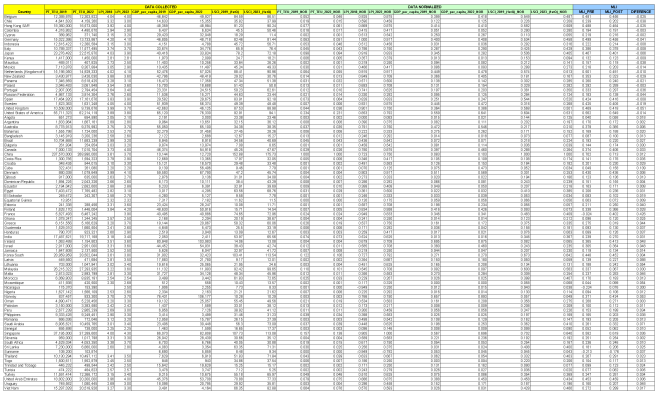
Appendix.

Table .3: Past decade scenario.

	DATA COLLECTED				DATA NORMALIZED				
Country	**LPI**	**LSCI**	**GDP**	**PT**	**LPI**	**LSCI**	**GDP**	**PT**	**MLI**
Albania	2.41	3.37	4,147	99,000	0.306	0.013	0.048	0.001	0.092
Algeria	2.77	5.55	3,844	360,522	0.445	0.026	0.044	0.002	0.129
Samoa	NA	5.22	NA	NA	-	0.024	-	-	0.006
Angola	2.24	29.67	3,111	1,000,000	0.243	0.171	0.035	0.006	0.114
Barbuda	2.96	4.22	14,353	31,718	0.517	0.018	0.178	0	0.178
Argentina	2.21	36.38	12,449	1,775,574	0.232	0.211	0.154	0.01	0.152
Aruba	NA	6.2	NA	167,514	-	0.03	-	0.001	0.008
Australia	3.79	30.64	49,928	7,524,343	0.833	0.177	0.632	0.041	0.421
Austria	4.1	NA	44,177	451,590	0.951	-	0.559	0.002	0.378
Bahamas	2.75	27.67	23,124	1,399,300	0.437	0.159	0.29	0.008	0.223
Bahrain	3.31	26.48	22,354	373,626	0.65	0.152	0.28	0.002	0.271
Bangladesh	2.66	12.62	1,359	1,655,365	0.403	0.068	0.012	0.009	0.123
Barbados	NA	4.92	16,097	71,468	-	0.022	0.2	0	0.056
Belgium	4.11	88.64	41,096	11,187,265	0.954	0.526	0.519	0.062	0.515
Belize	NA	7.8	4,811	41,693	-	0.039	0.056	0	0.024
Benin	2.43	18.34	789	408,146	0.316	0.103	0.005	0.002	0.106
Bermuda	NA	1.29	NA	NA	-	0	-	-	0
Brazil	3.09	39.93	8,650	10,678,564	0.567	0.233	0.105	0.059	0.241
Darussalam	2.87	3.86	26,939	129,026	0.483	0.015	0.339	0.001	0.209
Bulgaria	2.81	4.86	7,351	183,764	0.46	0.021	0.089	0.001	0.143
Cabo Verde	NA	4.1	2,998	NA	-	0.017	0.033	-	0.013
Cambodia	2.8	5.61	1,270	288,905	0.456	0.026	0.011	0.002	0.124
Cameroon	2.15	15.01	1,033	367,332	0.209	0.083	0.008	0.002	0.075
Canada	3.93	42.64	42,158	5,578,006	0.886	0.249	0.533	0.031	0.425
Cayman Islands	NA	2.12	NA	51,905	-	0.005	-	0	0.001
Chile	3.25	36.3	13,793	3,742,520	0.627	0.211	0.171	0.021	0.257
China	3.66	167.48	8,123	181,635,245	0.783	1	0.099	1	0.72
China	4.07	101.02	43,681	22,300,000	0.939	0.6	0.552	0.123	0.554
China	3.7	75.75	NA	16,430,542	0.796	0.448	-	0.09	0.334
Colombia	2.61	52.98	5,806	3,127,994	0.394	0.311	0.069	0.017	0.195
Comoros	2.59	5.38	775	NA	0.373	0.025	0.005	-	0.101
Congo	2.38	29.24	1,528	436,717	0.297	0.168	0.015	0.002	0.12
Costa Rica	2.65	11.49	11,825	1,960,267	0.399	0.061	0.146	0.011	0.154
Côte d'Ivoire	2.6	22.01	1,526	783,102	0.38	0.125	0.015	0.004	0.131
Croatia	3.16	32.51	12,091	176,596	0.595	0.188	0.149	0.001	0.233
Cuba	2.35	5.76	NA	300,836	0.285	0.027	-	0.002	0.078
Curaçao	NA	5.94	NA	NA	-	0.028	-	-	0.007
Cyprus	3	19.32	23,324	291,408	0.532	0.108	0.293	0.002	0.234
Congo	2.38	4.07	445	NA	0.297	0.017	0.001	-	0.079
Denmark	3.82	54.85	53,418	918,011	0.944	0.322	0.676	0.005	0.462
Djibouti	2.32	29.41	NA	773,141	0.274	0.169	-	0.004	0.112
Dominica	NA	2.05	7,144	NA	-	0.005	0.086	-	0.023
Republic	2.63	24.55	6,722	1,795,221	0.392	0.14	0.081	0.01	0.156
Ecuador	2.78	31.36	5,969	1,786,981	0.449	0.181	0.071	0.01	0.178
Egypt	3.18	62.5	3,514	8,810,990	0.601	0.368	0.04	0.049	0.264
El Salvador	2.71	8.93	4,224	189,811	0.422	0.046	0.049	0.001	0.13
Guinea	1.88	8.96	8,333	NA	0.106	0.046	0.101	-	0.063
Eritrea	2.17	3.49	NA	NA	0.217	0.013	-	-	0.057
Estonia	3.36	5.4	17,575	198,371	0.669	0.025	0.219	0.001	0.229
Faeroe Islands	NA	3.96	NA	NA	-	0.016	-	-	0.004
Fiji	2.32	8.56	5,153	NA	0.274	0.044	0.061	-	0.095
Finland	3.92	9.64	43,090	1,716,432	0.882	0.05	0.545	0.009	0.372
France	3.9	83.9	36,855	6,645,691	0.875	0.497	0.465	0.037	0.468
Polynesia	NA	12.09	NA	88,768	-	0.065	-	0	0.016
Gabon	2.19	9.38	7,179	197,996	0.234	0.049	0.087	0.001	0.09
Gambia	NA	6.04	473	NA	-	0.029	0.001	-	0.007
Georgia	2.35	5.73	3,854	446,972	0.285	0.027	0.044	0.002	0.09
Germany	4.23	97.75	41,936	19,685,381	1	0.58	0.53	0.108	0.555
Ghana	2.66	20.7	1,513	833,771	0.403	0.117	0.014	0.005	0.135
Greece	3.24	47.41	18,104	3,929,877	0.634	0.278	0.226	0.022	0.287
Greenland	NA	2.3	NA	NA	-	0.006	-	-	0.002
Grenada	NA	4	9,469	NA	-	0.016	0.116	-	0.033
Guam	NA	8.33	NA	236,084	-	0.042	-	0.001	0.011
Guatemala	2.48	20.3	4,147	1,273,392	0.335	0.114	0.048	0.007	0.126
Guinea	2.36	8.92	508	NA	0.289	0.046	0.002	-	0.084
Guinea-Bissau	2.37	3.97	620	NA	0.299	0.016	0.003	-	0.078
Guyana	2.67	4.52	4,457	NA	0.407	0.019	0.052	-	0.12
Haiti	1.72	6.31	740	NA	0.046	0.03	0.005	-	0.02
Honduras	2.46	9.96	2,361	704,934	0.327	0.052	0.025	0.004	0.102
Iceland	3.35	4.36	59,977	235,892	0.665	0.018	0.76	0.001	0.361
India	3.42	46.24	1,709	11,655,635	0.692	0.27	0.017	0.064	0.261
Indonesia	2.98	27.19	3,570	11,900,763	0.525	0.156	0.041	0.066	0.197
Iran	2.6	24.63	NA	5,163,843	0.38	0.14	-	0.028	0.137
Iraq	2.15	4.88	4,610	NA	0.209	0.022	0.054	-	0.071
Ireland	3.79	9.49	61,606	834,511	0.833	0.049	0.781	0.005	0.417
Israel	3.66	37.36	37,293	2,446,000	0.789	0.217	0.471	0.013	0.371
Italy	3.76	67.41	30,527	11,312,777	0.821	0.398	0.384	0.062	0.416
Jamaica	2.4	20.05	4,868	1,638,100	0.304	0.113	0.057	0.009	0.121
Japan	3.97	78.9	38,894	20,744,461	0.901	0.467	0.491	0.114	0.493
Jordan	2.96	29.27	4,088	797,624	0.517	0.168	0.047	0.004	0.194
Kenya	3.33	13.66	1,455	1,010,000	0.658	0.074	0.014	0.006	0.188
Kiribati	NA	2.91	1,449	NA	-	0.01	0.014	-	0.006
of	3.72	115.61	27,539	23,796,846	0.906	0.688	0.346	0.131	0.493
Kuwait	3.15	8.89	NA	1,277,674	0.589	0.046	-	0.007	0.161
Latvia	3.33	3.62	14,118	349,763	0.658	0.014	0.175	0.002	0.212
Lebanon	2.72	35.1	7,914	1,210,400	0.426	0.203	0.096	0.007	0.183
Liberia	2.2	7.78	455	NA	0.228	0.039	0.001	-	0.067
Libya	2.26	4.86	NA	456,773	0.251	0.021	-	0.003	0.069
Lithuania	3.63	6.22	14,880	423,028	0.772	0.03	0.185	0.002	0.247
Madagascar	2.15	10.73	401	181,808	0.209	0.057	0	0.001	0.067
Malaysia	3.43	106.79	9,503	22,718,784	0.696	0.635	0.116	0.125	0.393
Maldives	2.51	7.59	8,602	69,778	0.346	0.038	0.105	0	0.122
Malta	3.07	57.69	25,059	3,003,003	0.559	0.339	0.315	0.017	0.307
Marshall Islands	NA	3.02	3,449	NA	-	0.01	0.039	-	0.012
Mauritania	1.87	6.26	1,079	94,665	0.103	0.03	0.009	0	0.035
Mauritius	NA	28.64	9,628	653,635	-	0.165	0.118	0.004	0.072
Mexico	3.11	50.88	8,201	5,273,945	0.574	0.298	0.1	0.029	0.25
Micronesia	NA	1.32	3,069	NA	-	0	0.034	-	0.009
Montenegro	2.39	3.19	6,701	NA	0.297	0.011	0.081	-	0.097
Morocco	2.67	64.72	2,832	3,070,000	0.407	0.382	0.031	0.017	0.209
Mozambique	2.68	9.51	382	328,200	0.411	0.049	0	0.002	0.115
Myanmar	2.46	6.37	1,275	244,888	0.327	0.031	0.011	0.001	0.093
Namibia	2.74	14.32	4,140	131,160	0.433	0.078	0.048	0.001	0.14
Netherlands	4.19	95.73	45,295	12,513,407	0.985	0.568	0.573	0.069	0.549
New Caledonia	NA	14.79	NA	116,150	-	0.081	-	0.001	0.02
New Zealand	3.39	20.81	39,427	3,250,908	0.681	0.117	0.498	0.018	0.328
Nicaragua	2.53	8.84	2,151	101,392	0.354	0.045	0.023	0.001	0.106
Nigeria	2.63	21.93	2,178	1,062,389	0.392	0.124	0.023	0.006	0.136
Is	NA	4.01	NA	NA	-	0.016	-	-	0.004
Norway	3.73	5.89	70,812	379,027	0.81	0.028	0.898	0.002	0.434
Oman	3.23	47.35	14,982	3,620,364	0.62	0.277	0.186	0.02	0.276
Pakistan	2.92	36.58	1,468	2,597,395	0.502	0.212	0.014	0.014	0.186
Palau	NA	1.32	13,626	NA	-	0	0.169	-	0.042
Panama	3.34	53.42	13,680	7,942,291	0.662	0.314	0.17	0.044	0.297
Guinea	2.51	7.52	NA	382,301	0.346	0.037	-	0.002	0.096
Paraguay	2.56	NA	4,080	10,540	0.365	-	0.047	0	0.103
Peru	2.89	37.8	6,046	2,234,582	0.49	0.22	0.072	0.012	0.199
Philippines	2.86	17.81	2,951	5,869,427	0.479	0.099	0.033	0.032	0.161
Poland	3.43	52.5	12,372	2,051,718	0.696	0.308	0.153	0.011	0.292
Portugal	3.41	48.16	19,813	2,857,948	0.688	0.282	0.248	0.016	0.308
Qatar	3.6	5.2	59,331	445,845	0.76	0.024	0.752	0.002	0.385
Romania	2.99	29.89	9,474	775,743	0.529	0.172	0.116	0.004	0.205
Federation	2.57	42.57	8,748	3,903,250	0.369	0.248	0.107	0.021	0.186
Saint Helena	NA	NA	NA	838	-	-	-	0	0
Nevis	NA	2.35	16,725	NA	-	0.006	0.208	-	0.054
Saint Lucia	NA	4.63	7,744	71,364	-	0.02	0.094	0	0.029
Saint Vincent	NA	4.25	7,030	24,293	-	0.018	0.085	0	0.026
Samoa	NA	5.22	4,028	NA	-	0.024	0.046	-	0.018
Prin.	2.33	6.04	1,756	NA	0.278	0.029	0.019	-	0.081
Saudi Arabia	3.16	61.79	20,029	6,326,861	0.593	0.364	0.251	0.035	0.311
Senegal	2.33	12.77	958	450,008	0.278	0.069	0.007	0.002	0.089
Seychelles	NA	7.92	15,076	NA	-	0.04	0.187	-	0.057
Sierra Leone	2.03	7.61	496	NA	0.163	0.038	0.001	-	0.051
Singapore	4.14	122.7	52,961	34,832,376	0.966	0.731	0.67	0.192	0.64
Slovenia	3.18	33.23	21,305	647,240	0.601	0.192	0.267	0.004	0.266
Islands	2.42	6.62	2,005	NA	0.312	0.032	0.021	-	0.091
Somalia	1.75	6.52	434	NA	0.057	0.031	0.001	-	0.022
South Africa	3.78	37.1	5,274	4,831,462	0.829	0.215	0.062	0.027	0.293
Spain	3.73	86.13	26,528	14,710,955	0.81	0.511	0.333	0.081	0.434
Sri Lanka	NA	63.21	3,835	4,907,900	-	0.373	0.044	0.027	0.111
Sudan	2.53	18.41	2,415	565,811	0.354	0.103	0.026	0.003	0.121
Suriname	NA	4.98	6,484	NA	-	0.022	0.078	-	0.025
Sweden	4.2	58.84	51,600	1,684,198	0.989	0.346	0.653	0.009	0.499
Switzerland	3.99	NA	78,813	127,630	0.909	-	1	0.001	0.477
Rep.	1.6	13.37	NA	836,288	0	0.073	-	0.005	0.019
Thailand	3.26	44.32	5,908	8,283,756	0.631	0.259	0.07	0.046	0.252
Togo	2.62	30.29	578	NA	0.388	0.174	0.002	-	0.141
Tonga	NA	2.94	3,689	NA	-	0.01	0.042	-	0.013
Tobago	2.4	17.39	15,377	738,630	0.304	0.097	0.191	0.004	0.149
Tunisia	2.5	5.35	3,689	600,986	0.342	0.024	0.042	0.003	0.103
Turkey	3.42	49.61	10,788	7,622,559	0.692	0.291	0.133	0.042	0.289
Ukraine	2.74	31.37	2,186	849,262	0.433	0.181	0.023	0.005	0.161
Emir.	3.94	70.57	37,622	20,900,567	0.89	0.417	0.475	0.115	0.474
United Kingdom	4.07	97.23	39,899	9,347,944	0.939	0.577	0.504	0.051	0.518
Tanzania	2.99	9.67	879	638,023	0.529	0.05	0.006	0.004	0.147
United States	3.99	98.7	57,467	46,488,523	0.909	0.586	0.728	0.256	0.62
Uruguay	2.97	34.93	15,221	904,911	0.521	0.202	0.189	0.005	0.229
Vanuatu	NA	6.17	2,861	NA	-	0.029	0.032	-	0.015
Venezuela	2.39	8.46	NA	1,416,970	0.3	0.043	-	0.008	0.088
Viet Nam	2.98	62.84	2,186	9,531,076	0.525	0.37	0.023	0.052	0.243

Table .4: Precovid (2019) vs. post covid (2022) scenarios.



The results of the experiment are also available at: Mendeley Data, V1, doi: 10.17632/8gx3rb5dc3.1.