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The impact of the COVID-19 pandemic on the Tunisian La-Goulette port's activity

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ABSTRACT

The COVID-19 pandemic has had a globally unprecedented effect on human mobility. In this respect, maritime activities, including passenger traffic, have been significantly impacted by stringent human movement associated restrictions. In this context, the present study is conducted to examine the COVID-19 health crisis implications on maritime passenger traffic, by focusing on the Tunisian La Goulette port undertaken operations. To this end, the Ordinary Least Squares (OLS) method, applying a time series dataset relevant to the period ranging from the first quarter of 2019 to the second quarter of 2023, has been deployed. Our reached findings turn out to reveal that maritime passenger traffic is negatively influenced by both the number of confirmed COVID-19 cases (CAS) and the Consumer Price Index (CPI). Inversely, however, the exchange rate (PRI) and the COVID-19 Health Measures Stringency Index (MSI) appear to display a positive impact on passenger traffic. Such findings are intended to provide ferry companies, cruise operators, and port authorities with valuable insights and guidance to enhance their strategies, thereby, mitigating the impacts of such unpredictable events and shocks as the COVID-19 pandemic.

1. Introduction.

One of the major shocks marking the year 2020 is the worldwide spread of the COVID-19 pandemic and its ensuing impacts on the global economy. Initially sprung in Wuhan, China, by the end of 2019, the COVID-19 deadly virus soon spread to the European Union, America, Africa, and Asia in a mysterious way, which aggravated its effects, leading subsequently to a deteriorating world economy through a sharp decline in investment, production, increased unemployment and social stress.

Certainly, most countries' immediate priority has been to limit the epidemic's repercussions, particularly noticeable though increasing health expenditure to strengthen the health sector's capacities and resources, accounting for the necessary provisions likely to impede and curb the predominance of the pandemic. Hence, human oceanic activities have also been radically altered as a result of the pandemic, with reports of significant port restrictions and shifts in consumption patterns affecting most maritime sectors, including fisheries, passenger ferries and cruise ships, as sectors heavily reliant on the transportation of people and goods. Thus, considering the critical role maritime transport plays in the increasingly expanding global economy, it is estimated that this sector should account for roughly 70% of the world trade value, and for around 80% of its total volume of (Kammoun and Abdennadher, 2022, 2023). As has been the case with most of the previously occurring economic recessions, the COVID-19 pandemic crisis has also been associated with noticeable changes in vessel movement.

Unlike most of the various challenges Tunisia has already encountered over time, the recently witnessed health crisis has had a significantly detrimental impact on the country's economy. Indeed, the COVID-19 pandemic's rapid and extensive spread throughout the country led to the implementation of stringent lockdowns and travel restrictions, adversely effecting most of the global shipping industry interfering areas, including mar-

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itime traffic, trade, container and oil transportation, as well as passenger transport.

Standing out in the western Mediterranean basin, the La Goulette ports represents a major sought-after destinations that serves as a crucial hub, wherein, Tunisia's major road and rail networks converge. Indeed, located in the historically affluent, culturally diverse, and densely populated area that bears its name (La Goulette), which englobes the capital Tunis and its suburbs, it is considered as Tunisia's foremost passenger port. According to the Merchant Marine and Ports Authority's official website 2019 launched statistics, the La-Goulette port accommodated a substantial influx of 857750 passengers, and hosted 323488 ships. In this context, the present study is conducted to examine the Covid-19 health crisis associated repercussions on passenger maritime transport, focusing particularly on the La-Goulette port undertaken operations. To this end, the Ordinary Least Squares (OLS) method, applying a time series dataset relevant to the period ranging from the first quarter of 2019 to the second quarter of 2023, has been used.

This work is organized as follows. Section 2 provides a depiction of the most recently released literature elaborated on the COVID-19 pandemic's impacts on ferry activity. As to Section 3, it provides a thorough depiction of the La-Goulette port, while Section 4 is dedicated to highlighting the methodology applied in our study. Section 5 is devoted to identifying the applied variables and corresponding definitions. As regards Section 6, it involves a discussion of the study reached findings, and the ultimate section bears the major concluding remarks and comments.

2. A literature review on the COVID-19 impact on ferry activity.

Following the unpredicted emergence of the COVID-19 pandemic, the transportation and logistics industry has been faced with significant difficulties and hardships. These challenges have been manifested in various ways, particularly, the imposition of stringent import and export restrictions, a significant decrease in demand for passenger travel, and changes in customer relationships among transportation companies throughout the COVID-19 pandemic prevalence span (Karaman et al., 2020; Mitrega and Choi, 2021).

Worth citing among the research works addressing the COVID-19 pandemic's effects on freight traffic, is the study conducted by Zhou et al. (2022), wherein the authors highlighted the pandemic's serious outcomes on the Shanghai Container Port's operations, stressing the ensuing economic setbacks faced by the port. They also provided some strategic recommendations useful for enhancing recovery. Their reached findings indicate well that significant losses are mainly related to such areas as port dues, handling services, as well as security facility and mooring fees. As for Cariou and Notteboom (2023), they investigated the COVID-19 pandemic's outcomes on the container import flows across the US port distribution network. By applying data relating to more than 21 U.S. ports and tracking over 550000 container shipments via Walmart and Nike, they considered drawing patterns and possible shifts occurring in the U.S. port distribution system. Their attained results turn out to indicate the persistence of several noticeable alterations in distribution channels throughout the pandemic period at both of the aggregated-port as well as specific-industry levels.

At this level, we proceed with examining the literature dealing with the COVID-19's effects on ferry operations. Worth recalling, in this respect, is the study conducted by Depellegrin et al. (2020), who applied a comparative spatio-temporal approach to examine the extent to which national lockdown policies impacted several types of vessels' movement, including fishing vessels, passenger ships, oil tankers, and cargo ships, over the time span ranging from March to April 2020. Their findings revealed a substantial decline in vessel activity during the lockdown period, with a noticeable reduction of 69% compared to the same period of 2017. Accordingly, also, passenger traffic experienced a rather noticeable decline by 78%, while fishing activities demonstrated the most significant reduction, of the rate of 84%, throughout the same period.

On another context, Chen et al. (2022) relied on Automatic Identification System (AIS) based data to analyze the COVID-19 associated effects on passenger transportation in Danish waters. They also examined variations in passenger ship activities and emissions before and after the pandemic's outbreak. Their reached findings recorded significant reductions in SOx emissions, wherein, cruise ships experienced a decrease by 50.71%, ferry-pax vessels by 0.51%, and ferry-ropax vessels by 0.82%. In another study conducted by Smirnov et al. (2022), the authors considered determining the main reasons lying behind the maritime cruise sector's collapse face to the COVID-19 pandemic. Based on statistical data on passenger traffic, revenue and financial results regarding five of the world's largest cruise lines, they noted that the companies' stocks turned out to fall on a daily basis, to record the lowest levels by March 2020. As to Murch et al. (2022), they applied linear mixed-effect model (LMM) to evaluate the containment measures' effects on the noticeable alterations marking the Western Mediterranean marine traffic density, over the first halves of the years 2019 and 2020. Their findings indicated the persistence of a significant decrease, by 70.2%, regarding exclusive economic zones, highlighting that the most substantial global declines took place in April, registering a 1.4% reduction in traffic occupancy, affecting 54.8% of the sample units. They also stressed that passenger ships tended to experience rather significant and enduring declines in traffic patterns. With respect to Mujal-Collilles et al. (2022), they relied the Automatic Identification System (AIS) based real-time data to estimate the COVID-19 pandemic's impact on maritime activity and the ensuing emissions regarding the Barcelona Port, over the period span ranging between March and July 2020. Their attained results proved to demonstrate that during the stringent lockdown period spanning from March to June 2020, a noticeable decrease in maritime passenger traffic was recorded to persist at the Port of Barcelona, coupled with a modest reduction in passenger ship released air pollutant emissions (-1.8% in CO2 emissions).

In turn, and on applying regression models to investigate the pandemic's effects on roll-on/roll-off passenger volume in Finland, Hilmola (2022) concluded that Covid-19 culminated in a

14.9 million loss in passenger volumes, engendering a 1.178 trillion Euros drop in turnover. They outlined that despite government support mechanisms put forward to attenuate the pandemic's impact on passenger volume, the situation did not tend to ameliorate by 2021, and the subsidies continued to be provided, while revenues barely increased and financial profitability was too limited. Similarly, Tapaninen and Palu (2022) documented that the Covid-19 pandemic led to a noticeable decline in passenger volumes regarding the Helsinki and Tallinn bound traffic, resulting in a serious financial problem to shipping companies. As to Maiorov and Fetisov (2022), who used graph modeling techniques to analyze the Covid-19 related effects on the Baltic Sea ferry and cruise routes, they concluded that coupled with the stringent price competition among carriers, the pandemic has remarkably impacted passenger traffic in the region. As regards the Mannarini et al. (2022) conducted study, linear mixed-effect model were applied to examine the COVID-19 impact on European vessel activity throughout the year 2020, to reach the conclusion that a remarkable reduction in unitary CO2 emissions was perceived in 2020, clearly associated with the predominance of the COVID-19 pandemic. This reduction appeared to range between 14% and 31% regarding the largest ferries, denoting a noticeable decline in ferry traffic. The authors also documented that per-ship emissions experienced an extra 18% decrease with respect to the North Sea area.

Thus, based on prior research drawn insights, one could well deduce the existence of an adverse correlation between the COVID-19 health crisis and maritime passenger and ferry traffic. Hence, the need to investigate the outcomes' ramifications of COVID-19 associated impacts on the La-Goulette port maintained operations, as the unique Tunisian port exclusively dedicated to handling passenger and ferry traffic.

3. Overview of the La-Goulette port.

The port is sited in the western Mediterranean region, in the north of Tunisia. Historically, it played a pivotal role in handling most of the country's maritime trade until the mid-1980s. However, since its international trade debut in 1987, the Port has been predominantly focused on handling passenger and cruise ship traffic.

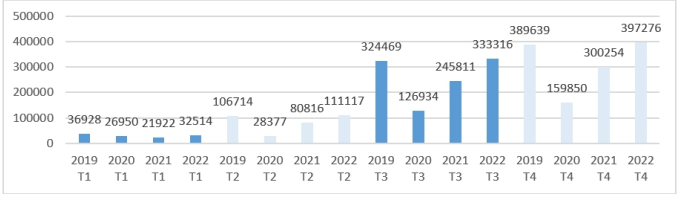
This ferry specializing port draws its importance from the crucial links it maintains with a wide range of destinations, involving the Port of Marseille in France, along with several Italian ports including Civitavecchia, Genoa, Salerno, and Palermo in Sicily. Most often, cruise tourists disembark at the La-Goulette port, wherein, they have the opportunity to explore the tourist village of La Goulette, typically renowned for the wide range of Tunisian handicraft specificities it offers. They could also visit the historical Medina site of Tunis as well as various archaeological monuments.

In effect, the port of La-Goulette keeps maintaining bustling operations and activities not only during the full summer season, but also round the year, particularly during the periods spanning from late December to the end of January and the vacation-season weeks abroad, characterized with a significant influx of travelers. Moreover, the port stands as the primary access point for an annual average number of 50000 vehicles, while playing a pivotal role in facilitating the reception of Tunisian car dealers' imported automobiles.

As the year 2020 was marked with an unprecedented health crisis, namely, the widespread of the Covid-19 pandemic, maritime transport encountered significant challenges relating to the implementation of various health-crisis combating measures, including lockdowns, curfews, non-essential business closures, travel restrictions, and others. The relevant impacts were particularly pronounced during the lockdown early stages, initially effective in Tunisia ever since March 13, 2020. In this respect, the Tunisian maritime transport sector started to experience the pandemic associated repercussions, marked with a severe economic slowdown along with the adoption of containment measures by several countries. Above all, the year 2020 was marked with the widespread of the Covid-19 global health crisis.

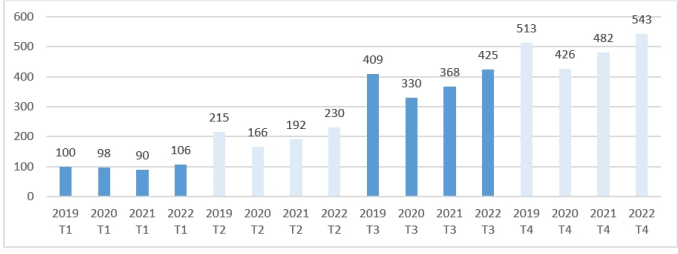
Based on the Office of Merchant Marine and Ports (OMMP) authority released data, the COVID-19 pandemic had a significant impact on the Tunisian maritime transport sector. In 2020, the number of individual sea travelers noticeably decreased, substantially by 56%, registering a total number of 342111 passengers recorded at the Tunisian access ports, according to the OMMP maintained records. Similarly, the OMMP recorded a 6% reduction in the number of hosted vessels, with only 1020 ships registered for entry at the La-Goulette port during 2020.

Figure 1: Evolution in passenger-traffic volumes from the first quarter of 2019 to the fourth quarter of 2022.



Source: OMMP.

Figure 2: Evolution in vessel traffic from the first quarter of 2019 to the fourth quarter of 2022.



Source: OMMP.

4. Methodology.

Our pursued econometric methodology involves expressing a particular phenomenon's specific behavior by means of equa-

tions, along with an estimation of these equations drawn coefficients through historical data specific to that phenomenon. Such an approach has been adopted for the sake of effectively comprehending, elucidating, replicating, and predicting the relevant phenomenon.

Hence, the ordinary least squares (OLS) approach, fit for implementation in this particular context, designates the mathematical regression technique frequently used in statistics, more specifically, in the linear-regression econometrics, requiring the alignment of a scatterplot of data points, represented as (Y, X), via a linear relationship.

In its full sense, an ordinary Least Squares (OLS) model estimation proceeds with minimizing the sum of squared differences between the recorded values and the predicted values. Such a procedure is undertaken to define the optimal coefficients enabling to effectively capture the variables binding relationship. It is worth noting that a simple linear regression model involves selecting key variables of two main types, i.e., a dependent variable (Y) and an independent one (X). Thus, an OLS estimation is designed to retrieve the regression line that minimizes the squares' sum of the deviations between the actual values of Y and the regression line predicted values. Hence, within a multiple linear regression framework, there should figure several independent variables (X1, X2, X3, etc.) along with a single dependent variable (Y). OLS estimation seeks to determine the most optimal coefficients fit for each independent variable, thereby, achieving a multiple linear model that provides the most accurately effective explanation of the dependent variable associated variability. This relationship is depicted as follows:

$$Y_t = \alpha + \beta_1\, CAS_t + \beta_2\, MSI_t + \beta_3\, PRI_t + \beta_4\, CPI_t + \lambda_t + \varepsilon_t \quad (1)$$

Where:

t designates the temporal index; α stands for an unknown constant; β denotes the independent variables' regression coefficient; Y_t stands for the dependent variable, denoting the La-Goulette port passenger traffic; CAS presents the number of confirmed cases; MSI denotes the COVID-19 Health Measures' Stringency Index; CPI designates the consumer price index; : PRI stands the TND-EUR exchange price; while, λ_t stands for the time-effects, and ε_t designates the error term.

The OLS modeling estimation process entails assessing a selection of hypotheses to ensure the attainment of a Best Linear Unbiased Estimator (BLUE) model. Such a procedure requires validating a set of relevant hypotheses in terms of:

- Normality of errors: assessing the normality of errors involves comparing asymmetry statistics among various models;
- Absence of errors relating autocorrelation;
- Homoscedasticity of errors.

Actually, validating these three hypotheses require constructing a robust model, enabling to attain reliably interpretable results.

5. Applied data.

To analyze the COVID-19 pandemic's effect on the La - Goulette port's operations, we have proceeded with collecting relevant data regarding the time period spanning from the first quarter of 2019 to the second quarter of 2023. In this context, passenger traffic (Y) are used as dependent variable. The relevant datasets have been outsourced from the official OMMP authority's website. In addition, four specific explanatory variables have also been selected, based on data availability, namely:

(a) The COVID-19 Health Measures' Stringency Index (MSI): initially established by the University of Oxford, this variable should serve to estimate the stiffness and strictness level of the public health measures and popular activities curtailing policies. This index represents a semi-quantitative metric englobing data from nine distinct public health interventions, involving such measures as school and workplace closures, public events' canceling, gatherings' sizes imposed limits, public transportation shut downs, home-stay implementation orders, domestic mobility regulations (within a country, province, or territory), international travel stringent control, and setting up public sensitization campaigns. Accordingly, a high MSI score should denote a highly rigorous response to the pandemic, wherein, a score of 100 reflects the most stringent measures being adopted and established. Initially implemented by Xu et al. (2020), this variable has been outsourced from the Tunisian Health Ministry's official website.

(b) The Number of confirmed cases (CAS): it is a metric measure that denotes the total number of Tunisian individuals positively tested for COVID-19. It stands as a key indicator reflecting the seriousness extent of the COVID-19 outbreak in the country. This data item has been widely referenced and utilized by various researchers, worth citing among whom are Mujal-Collilles et al. (2022) and Hilmola (2022). The relevant data have been directly downloaded from the official the Tunisian Health Ministry's website.

(c) The Consumer Price Index (CPI): it designates a macroeconomic variable that represents the main economic indicator used to track a particular country's inflation rate and living cost. It englobes a basket of goods and services, whereby, the basket price is computed in terms of the weighted average of the constituent items' retail prices. Applied by Xu et al. (2020), this variable has been drawn from the official Tunisian statistics agency's special website.

(d) The TND-EUR (PRI) exchange price: it stands for a macroeconomic variable, which is determined either as a valuation of a nation's country, or as other payers' issued loan. Initially applied by De Leon et al. (2009), the variable has been downloaded from the "Investing.com" website.

Our Ordinary least squares (OLS) modeling procedure has been conducted to estimate the primary factors influencing the La-Goulette port's operational performance throughout the COVID-19 pandemic predominance span, wherein, passenger traffic (Y) stands as a port productivity estimating indicator. Table

Table 1: The applied variables' descriptive statistics.

Variable	Obs	Min	Max	Mean	STD
Y	18	21922	397276	160607.8	134336.1
CAS	18	0	38371	7203.667	12007.36
MSI	18	0	97.63	46.07833	32.322
PRI	18	3.143	3.414	3.259	0.076
CPI	18	122.233	166.3	140.231	13.656

Source: Authors.

Table 2: The applied variables corresponding correlation coefficients.

	Y	CAS	MSI	PRI	CPI
Y	1.000				
CAS	-0.252	1.000			
MSI	0.382	0.448	1.000		
PRI	0.285	0.080	-0.215	1.000	
CPI	-0.129	0.021	0.090	0.296	1.000

Source: Authors.

1 provides a depiction of the applied variables corresponding descriptive statistics. As for Table 2, it displays the relevant correlation coefficients, wherein, the entirety of the coefficients turn out to be inferior to 0.5, affirming the absence of any multicollinearity problems among the selected variables.

For the purpose of estimating the determinants influencing the La-Goulette port's performance against the backcloth of the COVID-19 pandemic, we consider implementing the time-effects enclosing OLS approach. The administered analysis major attained findings have been achieved by means of Stata software, as highlighted in the section below.

6. Results.

6.1. Estimation and Results of the ordinary least squares modeling method.

An initial examination of the Stata 15 output reveals well that the model tends to demonstrate a noticeable overall significance. In effect, an 82% R-squared and an adjusted R-squared of 81% of the model's remarkable fit for implementation with the regression analysis selected data have been recorded. This is further substantiated by the Fisher statistic's specific probability, falling below the error threshold of 5%. In addition, the Durbin-Watson statistic, falling within the range of 0 to 4 and of a value rate of 2.007, highlights well the absence of autocorrelation within the sample, testifying well our pursued regression model's high performance and appropriate validity.

Table 3: Regression reached results.

Variables	Coefficient	P-value
CAS	-214.879	0.000***
MSI	188.379	0.017**
PRI	354.212	0.016**
CPI	-649.462	0.006***
T2 (2019)	263.186	0.017**
T3 (2019)	1.629	0.036**
T4 (2019)	204.62	0.033**
T1 (2020)	-188.647	0.101
T2 (2020)	-0.001	0.000***
T3 (2020)	-1.335	0.023**
T4 (2020)	-0.190	0.947
T1 (2021)	-188.379	0.023**
T2 (2021)	-34.286	0.042**
T3 (2021)	-78.647	0.007***
T4(2021)	26.359	0.037**
T1 (2022)	17.411	0.016**
T2 (2022)	14.532	0.031**
T3 (2022)	40.389	0.011**
T4(2022)	24.340	0.040**
T1 (2023)	54.367	0.042**
T2 (2023)	19.466	0.020**
CST	226.359	0.019**
R-squared		0.820
Adj R-squared		0.810
Prob (F-statistic)		0.002
Durbin -Watson		2.007
N		18
The significance thresholds are respectively set at: 1% (***), 5% (**) and 10% (*).		

Source: Authors.

Accordingly, the achieved findings turn out to indicate that maritime passenger traffic has actually been negatively affected by the number of COVID-19 confirmed cases (CAS). Indeed, a notable gap in passenger traffic has been recorded, dwindling down from 106714 passengers, throughout the second quarter of 2019, to 28377 passengers, during the second quarter of 2020, marking the pandemic onset. At this level, and with the rising numbers of confirmed COVID-19 cases, travelers began to grow rather superstitious, health caring and safety apprehensive. As a matter of fact, the fear of attaining the Corona virus infection risks while on a maritime trip has certainly dis-

couraged people to travel, therefore, traffic has been noticeably reduced. Furthermore, the rising figures of COVID-19 infected cases' might well undermine the maritime passenger confidence in travel associated activities. Indeed, passengers are most often unwilling to make any travel plans or bookings once uncertain about the predominant sanitary situation, thereby, maritime passenger traffic turns out to be declined. On the other hand, maritime transport suppliers might also be faced with the Covid pandemic related operational rules and constraints, including, reduced schedules, capacity limitations, implementation of imposed health protocols and vaccination requirements, thereby, restricting traveling operations while discouraging potential travelers.

Negatively correlated with maritime passenger traffic, a rise in Consumer Price Index (CPI) is usually associated with significant increases in good and service prices throughout a particular time period. As a sign of inflation, it designates a general increase in living costs within a specific economy, clearly manifested in a reduced currency purchasing power, therefrom, effectively decreasing the quantity of services and merchandises one could purchase with the same quantity of money. With respect to the tourism area, however, a higher CPI would also affect the tourists' purchasing potential, whose income and savings might well fail to cope with rising inflation, thus, being faced with shrinking leisure devoted income, mainly, travel. Therefore, not only the number of tourists would shrink, but also their visits allocated budget. Hence, in situations of price-escalation due financial constraints, consumers would often opt for cutting in discretionary expenditures, including leisure travel activities. This provides a plausible explanation of the maritime passenger traffic descending trend, which went down from 324469, in the third quarter of 2019, to 126934, in the third quarter of 2020. Such a noticeable decrease in the number of passengers was coupled with an increase in Consumer Price Index (CPI), going up from 125.633, in the third quarter of 2019, to 134.366, in the third quarter of 2020.

Additionally, the attained results turn out to reveal the persistence of a positive correlation between the exchange rate (PRI) and passenger traffic, particularly regarding the Tunisian Dinar (TND) versus the Euro (EUR) exchange rate context. Such a relationship is mainly due to the significant effect of currency exchange costs highly affecting maritime passenger traffic in Tunisia, and reflecting special economic impacts. In fact, the Tunisian Dinar (TND) exchange level might well make of Tunisia a rather low-price resort for Europeans, likely to perceive Tunisia as a highly attractive travel option, owing mainly to the Euro's higher exchange rate relative to the TND. Similarly, the Euro/Dinar differential exchange rate is another factor maintaining the fact that the hostelry and restauration sector, along with other local businesses turn out to offer competitive prices in relation to several other countries' provided costs, thereby, representing a rather attractive destination for visitors. Hence, the TND and EUR binding exchange rate dynamics would actually have remarkable impacts on Tunisia's maritime travel industry. In effect, a rather favorable exchange rate level, could well provide greater impetus to maritime passenger traffic inflows, thereby, enhancing not only the tourism industry, but also the national economy as a whole. Actually, a boost in maritime passenger traffic would be highly beneficial not only for the ferry companies, but also for cruise operators, port services, and the relating businesses, with promising increased revenues and positive potentials for the employment sector.

The achieved results also indicate the existence of a positive correlation binding the COVID-19 Health Measures Stringency Index (MSI) and the number of passenger. Indeed, a high (MSI) Index denotes well that Tunisia has undertaken to implement stringent public health policies in a bid to stop the propagation of the COVID-19 pandemic. In effect, such an association might well have it justification in the fact that an elevated MSI is but the result of stiff testing and safety measures, intended to reassure and heighten traveler confidence, and therefore, should not necessarily culminate in a declining maritime passenger traffic. Thus, on perceiving Tunisia as a safe destination with a wide range of safety and sanitary guarantees being put in place, certain travelers would not feel inclined to visit it, thereby, maintaining sea passenger traffic stability, or even boosting its status. Such a trend is particularly important in the case high travel demand circumstances, even in presence of stiff pandemic-related restriction measures. Throughout the third quarter of the year 2020, for instance, the COVID-19 related MSI index proved to record a threshold of 49.07, in return for a passenger score of 126934 travelers. Inversely, however, during the third quarter of 2021, with the COVID-19 Health Measures Stringency Index (MSI) hitting the threshold of 79.63, a significant improvement in passenger figures has been scored, recording a ceiling of 245811 travelers. Such findings tend to corroborate the results published by Xu et al. (2020).

Starting from the fourth quarter of 2021, however, positive and statistically significant temporal effects were recorded, as an outcome of effective governance and the professional medical staff's unwavering joint commitment, displaying a remarkable role in gradually attenuating and combatting the prevailing pandemic. It is actually thanks to these combined factors that the health situation started to consistently demonstrate a noticeable improvement, leading the La-Goulette port to recover and resume its normal frequent activities. As a matter of fact, such an achievement highlights well the high efficiency associated with the undertaken crisis-management measures, as well as the healthcare sector's endurance, capacity and willingness to confront and curb such unparalleled sanitary challenges.

6.2. Model validation.

For an effective assessment of the Ordinary Least Squares (OLS) model's robustness, and to pinpoint any potential residuals associated problems, likely to emanate within the OLS regression context, a selection of diagnostic tests have been administered. In this regard, the Jarque-Bera test has been administered to evaluate the residuals' normality level, while the White test has been conducted to detect the existence of any heteroscedasticity problems. As to the Breusch-Godfrey test, it has been applied to identify any autocorrelation issue. The tests achieved results, administered to control for any presumed residuals, are depicted on the table below.

Table 4: The diagnostic (Bera, White, and Breusch-Godfrey) tests reached results.

	Statistic	Probability
Jarque-Bera test	0.789	0.638
White test	13.74	0.469
Breusch-Godfrey test	0.106	0.936

Source: Authors.

As illustrated through Table 4, the diagnostic tests' results appear to reveal that the Jarque-Bera test attained probability value turns out to be of the rate of 0.638, exceeding the threshold of 0.05, therefore, the residuals prove to follow a normal distribution at a significance level of 5%. Similarly, the White's test probability value is of the rate of 0.469, which clearly exceeds the threshold of 0.05, highlighting the absence of any heteroscedasticity problem in our applied model within a significance level of 5%. As regards the Breusch-Godfrey test reached probability value, it has been equal to 0.936, clearly exceeding the threshold of 0.05, indicating the absence of any inter-residual serial correlations at a significance level of 5%. Thus, based on the table provided results, the entirety of administered tests turn out to testify the applied model's robust nature. Accordingly, the validation tests drawn probabilities tend to support the BLUE (Best Linear Unbiased Estimator) model advanced core hypothesis, thereby, maintaining a high confidence level regarding the robustness of the present analysis drawn interpretations.

Conclusions

The present research is conducted to explore the COVID-19 health crisis impact on the current status of the Tunisian La-Goulette seaport, uniquely specializing in passenger maritime transport. To this end, the OLS model has been applied to analyze a time series spanning from the first quarter of 2019 to the second quarter of 2023.

A comprehensive analysis of the findings achieved turns out to reveal the persistence of a negative effect of the COVID-19 pandemic on the maritime sector. The number of confirmed COVID-19 attained cases has been discovered to display a negative correlation with passenger shipping traffic, thereby, corroborating the Xu et al. (2020) released findings. In addition, the study also demonstrates that the Consumer Price Index (CPI) tend to be negatively associated with maritime passenger traffic. Indeed, increasingly ascending CPI could only dissuade tourists and passengers from targeting Tunisia as a desirable destination.

Noteworthy, however, is that the attained results prove to indicate the existence of a positive correlation between the COVID-19 Health Measures Stringency Index (MSI) and the number of passengers, highlighting that Tunisia's stringent COVID-19 pursued containment measures turned out to draw and attract massive passengers. Such findings tend to corroborate the results published by Xu et al. (2020). Additionally, the achieved results also reveal that the high Euro-TND exchange rate (PRI) levels contribute in boosting passenger traffic, making of Tunisia a rather cost-effective resort for European travelers, likely to consider Tunisia a rather attractive destination, accounting for the Euro's increased purchasing rate in relation to the TND.

Ultimately, one might well draw attention to a major limitation likely to be associated with this study, namely, its exclusive focus on the La-Goulette seaport of Tunisia, which has been mainly due to the unavailability of the neighboring countries' seaports relevant data. Hence, a potential research study venue could expand the research line so as to examine the effect of the COVID-19 pandemic's impacts on goods traffic, at an international scale level.

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