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Impact of COVID-19 on Morocco's Currency Exchange Rate: An ARDL Approach

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Abstract

This study delved into the repercussions of the COVID-19 pandemic on Morocco's exchange rate through the application of an Autoregressive Distributed Lag (ARDL) model. The dataset employed for this investigation encompassed daily time series data collected between March 23, 2020, to June 30, 2021. Our results suggest that, in the short run, COVID-19 new cases had a negative effect on Morocco's exchange rate. Over the long term, an increase in new COVID-19 cases adversely influenced the exchange rate. Furthermore, control variable like the Brent Oil Price Index negatively impacted the exchange rate. The study results are significant for policymakers, governmental authorities, and investors, as they provide valuable insights into how Morocco's exchange rate reacts during periods of uncertainty and crisis.

Keywords: COVID-19, Exchange Rate, Morocco

Introduction

The COVID-19 pandemic, which originated in late 2019, has had far-reaching consequences on a global scale. Its impact extended beyond health and public safety, deeply affecting various aspects of societies, economies worldwide. The pandemic disrupted global trade, travel, and supply chains, causing economic uncertainties and fluctuations. In this context, the impact of COVID-19 on exchange rates has become a critical concern, especially for countries like Morocco. As an emerging economy in North Africa, Morocco faces unique challenges and opportunities in the wake of this global crisis (Urom et al., 2023). The pandemic's economic disruptions, alongside government responses and international market dynamics, have the potential to significantly influence the Moroccan exchange rate (Bouasabah, 2022). Figure 1, it can be observed that the Moroccan dirham was valued at

10.30. This decline in value suggests that the Moroccan dirham weakened in comparison to the US dollar during the specified period of the COVID-19 pandemic.

In addition, the Moroccan dirham (MAD) is an essential component of the nation's monetary and financial system (Belcaid & El Ghini, 2021). It is the unit of account for pricing goods and services inside the nation since it is the country's official currency; hence, it is used for all transactions within the country (Moumni & Dasser, 2020). Market forces determine the exchange rate between the Moroccan dirham and other major currencies like the US dollar or the euro, which reflects the relative strength of the Moroccan economy (Lezar, 2023). The competitiveness of imports and exports, inflation rates, and the cost of repaying foreign debt are all susceptible to changes in response to shifts in the exchange rate (Forbes, 2016). Furthermore, currency values are highly sensitive to changes in economic conditions. In times of economic uncertainty, such as during a global pandemic like COVID-19, investors frequently shift their investments towards safer and more stable assets. This shift in investor behavior can significantly impact exchange rates (Aimer, 2021). Fluctuations in the exchange rate can influence the cost of imported goods and services in Morocco. A stronger dirham can make imports more affordable, potentially contributing to lower inflation rates. Conversely, a weaker dirham can make imports more expensive, potentially leading to higher inflation. These dynamics are closely linked to Morocco's trade relationships, as they can impact the balance of trade and the country's overall economic stability. Policymakers and businesses must carefully monitor and respond to these fluctuations to ensure that Morocco's economy remains resilient in the face of global economic challenges. Therefore, this study aims to conduct a comprehensive analysis to better understand the impact of the COVID-19 pandemic on the exchange rate in Morocco. Key questions to address include: What effects did the pandemic have on Morocco's exchange rate? What long-run and short-run consequences are anticipated?

The insights gained from this research will not only contribute to a deeper understanding of Morocco's economic resilience in the face of global crises but will also provide guidance to policymakers, businesses, and investors in their decision-making processes. Understanding the interplay between a global health crisis and exchange rate dynamics is essential for navigating the evolving financial landscape and fostering economic stability and growth in Morocco. This study offers valuable insights into how exchange rates, such as in the context of Morocco, respond to the impact of COVID-19 and the subsequent implications for exchange rate behavior. By exploring the intricate relationship between COVID-19 and exchange rate movements during times of crisis, it contributes to a deeper understanding of these dynamics. Importantly, this research provides a novel perspective, addressing a significant gap in the existing body of knowledge. As the first study of its kind to comprehensively analyze both long-term and short-term aspects, it delivers specific insights tailored to Morocco's exchange rate. This makes it a valuable resource for policymakers, market regulators, and investors seeking evidence-based strategies to effectively navigate crises in Morocco's exchange rate in the future.

Literature Review

In this section, we provide a comprehensive review of the empirical literature concerning the influence of COVID-19 on exchange rates. This review is structured based on the relationships investigated, the econometric techniques applied, and the outcomes. It also encompasses the most recent research on the interplay between the COVID-19 pandemic and exchange rates. So, many studies have found that COVID-19 has a negative impact on

the exchange rates, including Camba and Camba (2020); Beckmann and Czudaj (2022); Fang and Zhang (2021); Li et al. (2022); Shahrier (2022); Aquilante et al. (2022); Bouasabah (2022).

Camba and Camba (2020) Investigates the impact of the COVID-19 pandemic on the Philippine stock exchange, the peso-dollar exchange rate, and the retail price of diesel. The study employs robust least squares regression and vector autoregression (VAR). Using the MM-estimation method, the robust least squares regression determines that daily COVID-19 infections have a negative and statistically significant effect on the Philippine stock exchange index, the peso-dollar exchange rate, and the retail pump price of diesel. These findings align with the results obtained from correlation diagnostics. Regarding the VAR model, it is observed that the lag values of the independent variable play a significant role in explaining the fluctuations in the Philippine stock exchange index, the peso-dollar exchange rate, and the retail pump price of diesel. Additionally, in the short term, the impulse response function confirms the relative impact of COVID-19 daily infections, while the variance decomposition reveals that these infections only account for a minor portion of the fluctuations in the Philippine stock exchange index, peso-dollar exchange rate, and retail pump price of diesel. Over the long term, their influence diminishes. Furthermore, the Granger causality test suggests that daily COVID-19 infections lead to changes in the Philippine stock exchange index and peso-dollar exchange rate in the short run. However, there is no causal relationship between COVID-19 infections and the retail pump price of diesel.

Moreover, Beckmann and Czudaj (2022) COVID-19 pandemic on currency exchange rates is studied based on a comprehensive collection of survey projections for more than 50 different currency pairings. In the first step of the process, examine whether the plan to control the COVID-19 epidemic will affect the trajectory anticipated for exchange rates in the medium and long term. In the second step of the study, the study uses an event study analysis to locate instances of aberrant returns on foreign currency markets ever since the beginning of the COVID-19 epidemic. The study finds that policy responses to the COVID-19 pandemic strongly affect cumulated excess returns. This demonstrates that foreign exchange markets take expected policy effects into account as an important determinant of future developments, while expectations for minor currencies react more strongly to policies that respond to pandemics.

Fang and Zhang (2021) assume that the COVID-19 epidemic has an effect that is time-varying and asymmetric on the RMB exchange rate. Using the Taylor rule model, they analyse the changes in the RMB exchange rate around the time when COVID-19 was first discovered. They discovered that the rate of RMB gradually increased before the epidemic but varied while the pandemic was going on. This demonstrates that the pandemic had a fleeting influence that varied in intensity over time on the RMB exchange rate.

Furthermore, Li et al. (2022) aims to highlight the impact of COVID-19 confirmed cases and deaths in highly affected countries worldwide, such as China and the USA, with a specific focus on their respective currencies. The overarching objective is to gain a deeper understanding of the ongoing repercussions of COVID-19 on various economies. More specifically, the study seeks to comprehend the significance of COVID-19's persistent effects on multiple economies. Daily data from January 22, 2020, through May 7, 2021, were meticulously examined to achieve this objective. These data were then analyzed to explore the linear relationship between currency values and the COVID-19 pandemic. Furthermore, the Autoregressive Distributed Lag (ARDL) model was employed to fulfill the study's aims,

and a multitude of statistical diagnostic measures were utilized to validate the accuracy of the model. The findings show that in some countries, COVID-19 cases and fatalities have a negative impact on the currency exchange rate. Additionally, these pandemic-related effects are not limited to the short term; they also negatively impact the economic foundations of China and the United States.

In a related study, Shahrier (2022) investigates the impact of pure contagion and fundamentals-based factors on ASEAN-5 currency rates during the COVID-19 period using daily exchange rate data from June 2019 to December 2020. Several key findings emerge by applying VECM within a structural VAR framework and high-frequency wavelet analysis. The VECM analysis reveals that exchange rates among the ASEAN-5 countries are co-integrated during the pandemic, with specific adjustment rates noted for currencies like the Indonesian rupiah, Malaysian ringgit, and Singapore dollar. Regarding exchange rate volatility, Indonesia, Malaysia, and Singapore experience sustained high levels, while Thailand exhibits low short-term volatility but high long-term volatility. In contrast, the Philippines demonstrates low short-term volatility with no significant long-term fluctuations. Regarding contagion, the Indonesian rupiah is the first currency to respond to the COVID-19 shock, leading to fundamentals-based contagion affecting Malaysia and Thailand. Additionally, transient pure contagion driven by emotional factors impacts Singapore and the Philippines.

In addition, Aquilante et al. (2022) investigate the influence of COVID-19 news on currency rates, study used daily linear regressions and panel VAR. According to the research, negative pandemic news at the nation level results in an immediate, statistically significant devaluation of the local currency relative to a basket of trade-weighted currencies. This impact is stronger in free-floating economies. Bouasabah (2022) using the Autoregressive Vector (VAR) model as the foundation for investigation, they are looking at the possibility of a causal connection existing between the newly reported cases of the COVID-19 pandemic and the exchange rate of the Moroccan Dirham versus the official currency of the European Union. The Granger causality test provided conclusive evidence of this influence. On the other hand, the analysis that was based on the impulse response function and the variance decomposition method showed that the effect of an increase in new COVID-19 cases is transmitted to the exchange rate on the 7th day, as well as the shock caused by the pandemic on the exchange rate persists and lasts in time, which explains the possibility of a long-term effect.

Upon reviewing previous research, it is evident that COVID-19 has had an adverse effect on the exchange rate. This study aims to address this research gap by comprehensively investigating the effects of COVID-19 on the Moroccan exchange market in both the short- and long-run dimensions through the ARDL model.

Methodology

Model specifications

To relate the exchange rate to COVID-19, we estimate the following simple model based on the work of Habibullah et al. (2022), Habibullah et al. (2021), Obiakor et al. (2022), Dreger and Gros (2021), and Safuan et al. (2022).

$$Exchange\ rate_t = \lambda_0 + \lambda_1 new\ cases_t + \lambda_2 new\ deaths_t + \lambda_3 Z_t + \varepsilon_t \quad (1)$$

whereby the dependent variable is $Exchange\ rate_t$ which refers to the exchange rate for Morrocco, $new\ cases_t$ refers to Morrocco new cases, $new\ deaths_t$ refers to Morrocco new deaths and Z_t is control variable such as Brent crude oil.

Method of Estimation

We employ the Autoregressive Distributed Lag (ARDL) modeling technique to analyze cointegration, with the aim of estimating the enduring relationships between variables. This methodology is commonly referred to as the ARDL cointegration modeling approach and was originally proposed by Pesaran et al. (2001).

To assess the long-term relationships as described in Equation (1), the ARDL model can be applied to investigate the impacts of COVID-19 on Morocco's exchange rate over different time spans, encompassing both short-term and long-term effects. This analysis facilitates the estimation of the enduring impact on Morocco's exchange rate.

As per Pesaran et al. (2001), the long-term model depicted in Equation (1) can be derived from the short-term ARDL model.

$$Ex_{rate_t} = \tau_0 + \sum_{i=1}^{n} \tau_{1i}\, Ex_{rate_{t-i}} + \sum_{i=0}^{n} \tau_{2i}\, new\ cases_{t-i} + \sum_{i=0}^{n} \tau_{3i}\, new\ deaths_{t-i} + \sum_{i=0}^{n} \tau_{4i}\, Z_{t-i} + \omega_t \quad (2)$$

From Equation (1), we can derive the subsequent long-term model to estimate the ARDL long-run model, as deduced from Equation (2).

$$Ex_{rate_t} = \lambda_0 + \lambda_1\, new\ cases_t + \lambda_2 new\ deaths_t + \lambda_3 Z_t + \varepsilon_t \text{ with } \lambda_0 = \frac{\tau_0}{1-\sum \tau_{1_i}},\ \lambda_1 = \frac{\sum \tau_{2_i}}{1-\sum \tau_{1_i}},\ \lambda_2 = \frac{\sum \tau_{3_i}}{1-\sum \tau_{1_i}},\ \text{and } \lambda_3 = \frac{\sum \tau_{4_i}}{1-\sum \tau_{1_i}}. \quad (3)$$

Using the residuals generated from the long-term model, the researchers can additionally examine the existence of cointegration in the short-term Error Correction Model (ECM).

$$\Delta\, Ex_{rate_t} = \pi_0 + \sum_{i=1}^{m} \pi_{1i}\, \Delta Ex_{rate_{t-i}} + \sum_{i=0}^{m} \pi_{2i}\, \Delta\, new\ cases_{t-i} + \sum_{i=0}^{m} \pi_{3i}\, \Delta\, new\ deaths_{t-i} + \sum_{i=0}^{m} \pi_{4i}\, \Delta\, Z_{t-i} + \lambda\, ECT_{t-1} + \eta_t \quad (4)$$

The term ECT_{t-1} represents the residual from the long-term model with a lag of one period, specifically referring to Equations (1) or (3).

$$ECT_{t-1} = \varepsilon_{t-1} = EX\_rate_{t-1} - [\lambda_0 + \lambda_1\, new\ cases_{t-1} + \lambda_2 new\ deaths_{t-1} + \lambda_3 Z_{t-1}] \quad (5)$$

The parameter lambda (λ) within the error-correction term (ECT) at time ($t-1$) measures how quickly the variables adapt to reach the long-term equilibrium. When it is statistically significant, it typically takes on a negative value and usually falls within the range of 0 to -2, as suggested by Samargandi et al., (2015).

ARDL is a statistical methodology used for estimating a model's parameters. It proves particularly beneficial when the model encompasses both stationary (I(0)) and non-stationary (I(1)) variables, representing variables that either maintain a consistent mean over time or do not. The conditional error-correction model is employed to elucidate the enduring relationship among the variables under scrutiny, with a specific focus on how COVID-19 influenced the exchange rate in Morocco during the pandemic. The depiction of the conditional error-correction (ECM) model is as follows:

$$\Delta\, Ex_{rate_t} = \tau_0 + \sum_{i=1}^{p} \tau_i \Delta\, ex_{t-i} + \sum_{i=0}^{p} \tau_{2i} \Delta\, new\ cases_{t-i} + \sum_{i=0}^{p} \tau_{3i} \Delta\, new\ deaths_{t-i}$$

$$+ \sum_{i=0}^{p} \tau_{4i} \Delta\, Z_{t-i} + \beta_1\, ex_{t-1} + \beta_2\, new\ cases_{t-1} + \beta_3\, new\ deaths_{t-1} + \beta_4\, Z_{t-1} + \mu_t \quad (6)$$

which is H_0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$ in opposed to the alternative hypothesis H_1: $\beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq 0$

Furthermore, the research employed the Bound t-test, a cointegration test introduced by Banerjee et al. (1998), building on earlier work by Banerjee et al. (1986) and Kremers et al. (1992). The t-statistic associated with the coefficient of the lagged dependent variable in a conditional ECT_{t-1} forms the core of their test. This test confirms the presence of a long-term relationship between the variables, as determined by the F joint significance test.

Data collection

The authors detail the data collection process to fulfill the study's objectives. The dataset used in this investigation comprises daily time series data acquired from March 23, 2020, to June 30, 2021. The primary independent variable is the exchange rate (www.datastream.com). Two independent variables, specifically new cases and new deaths were gathered from (ourworldindata.org). These variables represent the daily counts of new COVID-19 cases and fatalities in Morocco. Furthermore, the analysis included control variables, which encompassed Brent crude oil data obtained from (www.datastream.com).
We employed a predetermined mathematical technique that entailed converting the original variables into their logarithmic counterparts, in accordance with the method suggested by Busse and Hefeker (2007). This transformation is expressed as $\log y_t = \log\left[y_t + \sqrt{(y_t^2 + 1)}\right]$ Table 1 provides a comprehensive summary of the variables under investigation, encompassing both dependent and independent variables, as well as the control variables. Additionally, Figure 1 shows the value of the Moroccan dirham. The observed depreciation indicates that the Moroccan dirham experienced a weakening relative to the US dollar throughout the designated timeframe associated with the COVID-19 pandemic.

Table 1.
Descriptions of variables

No	Variable	Data source	Measurements of variables	Role
1	Exchange rate (EX-RATE)	www.datastream.com	Bid-price daily	Dependent
2	New cases (NC)	ourworldindata.org	Daily	Independent
3	New deaths (ND)	ourworldindata.org	Daily	Independent
4	Brent Crude Oil (B.C.O)	www.datastream.com	Close price	Control

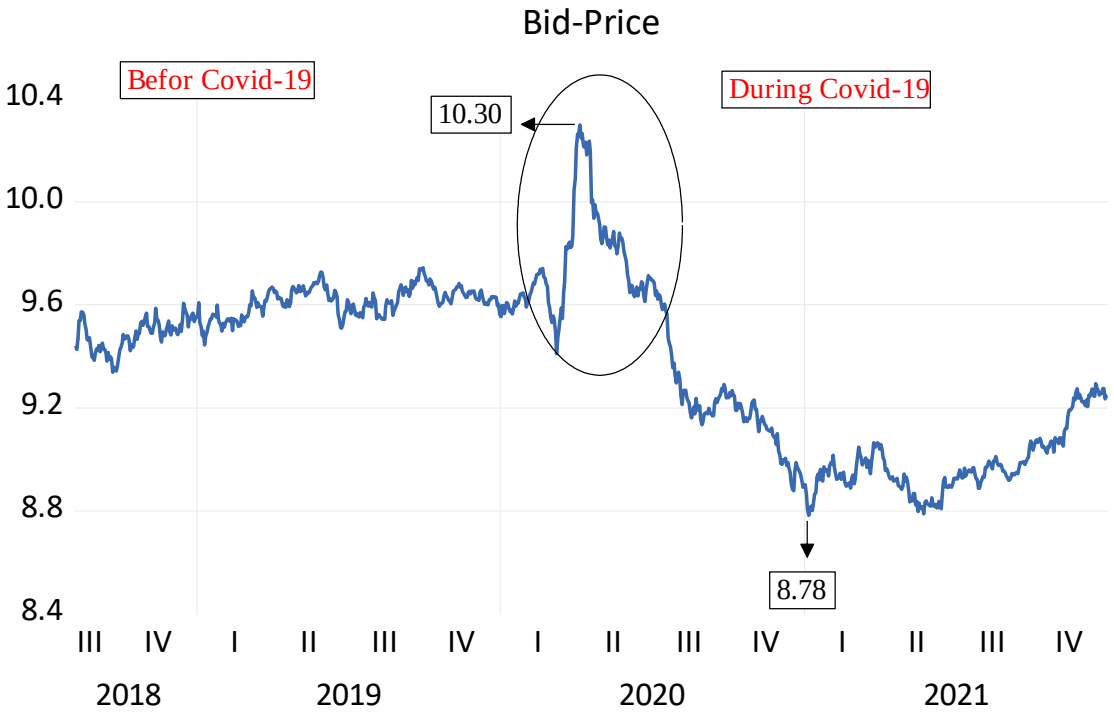

Figure 1. Bid-Price in Morocco pre-covid19 and during a pandemic.

The empirical results

Descriptive statistics, correlation and stationary.

In our empirical results, as presented in Table 2, we observe patterns consistent with prior studies by Agarwalla et al. (2021), Banerjee (2021), Malik et al. (2022), and Youssef et al. (2021). Specifically, certain variables exhibit a negative skewness, mirroring the characteristics seen in their research. Similar to their findings, we note that some variables have a left-skewed distribution, suggesting a longer tail on the negative side of the distribution. This negative skewness signifies that the data tends to have lower values with a few extreme observations on the negative end. The presence of negative skewness in these variables corresponds to the trends identified in the mentioned research papers, which further validates and aligns our study's outcomes with the broader literature on the subject. Furthermore, our investigation reveals that the kurtosis of the new cases variable exceeds a value of 3, which is in line with findings from studies by Banerjee (2021), Bourghelle et al. (2021), Fakhfekh et al. (2021), and Ftiti et al. (2021).

Additionally, Jarque-Bera test to assess the distribution of the variable. As depicted in Table 2, the test results indicate a test probability of 0%, signifying a significant departure of the

empirical data's distribution from a normal distribution. This result is consistent with observations made in studies conducted by Curto and Serrasqueiro (2022), Malik et al. (2022), and Youssef et al. (2021).

Table 2.
Descriptive statistics of the variables

	NC	ND	EX_RATE	B.C.O
Mean	6.6789	2.7270	2.9197	8.7372
Median	6.8090	2.6441	2.9097	8.6801
Maximum	9.4246	5.2983	3.0274	9.1843
Minimum	0.0000	0.0000	2.8692	8.0371
Std. Dev.	1.6384	1.5231	0.0412	0.2623
Skewness	-0.9759	-0.2495	0.8366	-0.1595
Kurtosis	5.0385	2.0155	2.5610	2.4118
Jarque-Bera	101.8943***	15.5839***	38.2797***	5.7279*

Note: All variables are in logarithms.

Correlation matrix.
The outcomes derived from the correlation matrix, as depicted in Table 3, disclose noteworthy associations among the variables. Particularly, a negative correlation is evident among the exchange rate, new cases, deaths, and the Brent Index. This correlation is found to be statistically significant at the 1% and 10% levels. The authors utilized the correlation matrix results as an initial step before employing the ARDL model to delve deeper into these interconnections in our research. Furthermore, the correlation matrix results establish a linear relationship among the variables, ranging from 1 to -1, which forms a strong foundation for the application of the ARDL model.

Table 3.
Correlation matrix.

Variables	Ex-Rate	NC	ND	B.C.O
Ex-Rate	1.0000			
NC	-0.4731***	1.0000		
ND	-0.4922***	0.8390***	1.0000	
B.C.O	-0.8335***	0.1115*	0.1026*	1.0000

Note: Asterisks ***, ** and * denote statistically significant at the 1%, 5% and 10% level, respectively.

Result unit root tests
ARDL model necessitates using a combination of data in both its original level and the first difference. The findings presented in Table 4 indicate that new cases and deaths are presented in their original levels. In contrast, the first difference presents variables such as the exchange rate and Brent oil price. This combination of data in both levels and first differences enables the ARDL model to comprehensively capture the interactions and

relationships between the variables across time, considering their long-term and short-term dynamics.

Table 4.
UNIT ROOT TEST (ADF)

Variables	Level:		First-difference:		Integration
	Constant	Constant+trend	Constant	Constant+trend	order
EX_RATE	-1.6756	-2.559	-5.1696***	-5.1759***	I(1)
NC	-3.4812***	-3.8811**	-	-	I(0)
ND	-4.3409***	-4.4277***	-	-	I(0)
B.C.O	-0.3675	-2.8311	-5.7137***	-5.7035***	I(1)

Asterisk *** and ** denotes statistically significant at the 1%, 5% levels, respectively.

Results of lag length

Before estimating the ARDL (Autoregressive Distributed Lag) model, the study used the Vector Autoregression (VAR) model to determine the appropriate lag length. This selection process involved the application of three commonly used information criteria: the Akaike Information Criterion (AIC), the Schwartz Criterion (SC), and Hannan-Quinn (HQ). The objective was to identify the lag order that best captures the most accurate relationships and dynamics among the variables. Following the application of the Vector Autoregression (VAR) model, a lag of 3 was identified as the most suitable choice based on the Akaike Information Criterion (AIC), as shown in Table 5.

Table 5.
VAR lag order selection criteria.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-98.8454	NA	2.31E-05	0.6766	0.7255	0.6962
1	1323.7340	2798.3640	2.21E-09	-8.5772	-8.3327	-8.4794
2	1375.0030	99.5011	1.76E-09	-8.8092	**-8.3690***	-8.6331
3	1406.0870	59.5104*	1.59e-09*	**-8.9084***	-8.2727	**-8.6541***

Note: Table outlines the criteria used for selecting the lag order. '*' indicates the lag order selected by the criterion these criteria, including Log Likelihood (LogL), Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), and Hannan-Quinn Information Criterion (HQ), provide different measures to evaluate the optimal lag orders.

Results of Cointegration Tests

Table 6 presents evidence of a cointegration relationship. The results indicate that the F-bound test value of 6.8990 is highly significant at the 1% level. Additionally, the t-statistic of -5.2798 is also statistically significant at 1%. This implies substantial statistical support for the assertion that the variables under consideration are indeed cointegrated. In simpler terms, they exhibit a long-term relationship where their movements are interconnected and tend to co-vary over time.

Result of ARDL model

Table 6 in the ARDL model, R-squared value of is 0.9925 indicating an excellent fit of the model to the data. Adjusted R2, which yields a value of 0.9923. Additionally, the Akaike Information Criterion (AIC) selection criterion has identified the optimal lag orders for the

variables in the ARDL model as (3, 1, 0, 1). This notation provides significant insights into the lag structure of each variable examined in our study.

The error correction term is -0.0637 of the COVID-19 impacts on the short-term exchange rate showed a negative impact at 1% before moving to the long-term. Looking at the long term, the occurrence of new cases has exerted a detrimental influence on Morocco's exchange rate. This implies that increasing new cases has negatively impacted the country's exchange rate. The control variable, the Brent index, negatively impacted the Moroccan exchange market. This might imply that changes in oil prices, as measured by the Brent index, dampened the exchange market, possibly due to their impact on the nation's economic circumstances and trade dynamics.

Understanding the relationship between controlled variables like the Brent index and exchange market performance is crucial for comprehending the broader economic context in which the Moroccan exchange market operates in a financial crisis. These findings emphasize the interplay between COVID-19 cases, oil prices, and exchange rates in shaping Morocco's economic conditions during the pandemic. They underscore the importance of monitoring and understanding these relationships to navigate the challenges of external and internal factors in a globalized economic context.

Diagnostics and Stability Tests

The results in Table 6, where the p-value exceeds 5% (specifically 0.7848), signify a significant absence of serial correlation in the model. This indicates that the unexplained variability in the data, as represented by the residuals, does not exhibit any systematic patterns or trends. The absence of serial correlation is a positive characteristic that enhances the model's reliability, validates its statistical robustness, and underscores its strong alignment with the data. Furthermore, Figure 2 illustrates the CUSUM test, which identifies structural changes or shifts in data patterns, staying well within the predefined critical boundaries when a 5% significance level is applied. This represents a crucial step in the validation process of statistical analysis, assuring that the observed trends or patterns are not the result of random fluctuations.

Table 6.

COVID-19 impact on the short-term and long-term performance of Morocco's Exchange Rate

ARDL (3, 1, 0, 1)		
Model selection method: Akaike info criterion (AIC)		
Part A.	Selected Model: (3, 1, 0, 1)	
R^2 and Adj. R^2	0.9925/0.9923	
Part B.	Residual Diagnostic	
LM χ (1)	[0.7848]	
Part C.	Long-run for COVID-19 and Exchange Rate	
Variables:	Coefficient:	t-Statistic:
NEW_CASES	-0.0143***	-2.9090
NEW_DEATHS	-0.0007	-0.1438
BRENT_CRUDE_OIL	-0.1215***	-9.6379
Part D.	Conditional ECM Bounds F-stat:	
F-stat	6.8990 ***	
K	3	
Part E.	Short-run ECM regression for COVID-19 and Exchange Rate:	
ECM*	-0.0637***	-5.2798
R-squared	0.1406	
Adjusted R-squared	0.1262	
S.E. of regression	0.0036	
Part F.	ECM regression Bounds t-stat:	
Bounds t-stat	-5.2798***	

Note: Asterisks (***, **, *) indicate statistically significant levels of 1%, 5%, and 10%, respectively. R^2 and Adjusted R^2 measure model fit, while LM χ (1), examine serial correlation in ARDL equations. Variable descriptions are detailed in Table 1. Cointegration is evaluated using the Bounds F-test, and a related Bound T-test, as proposed by Banerjee et al. (1998), focuses on long-term relationships based on lagged dependent variables.

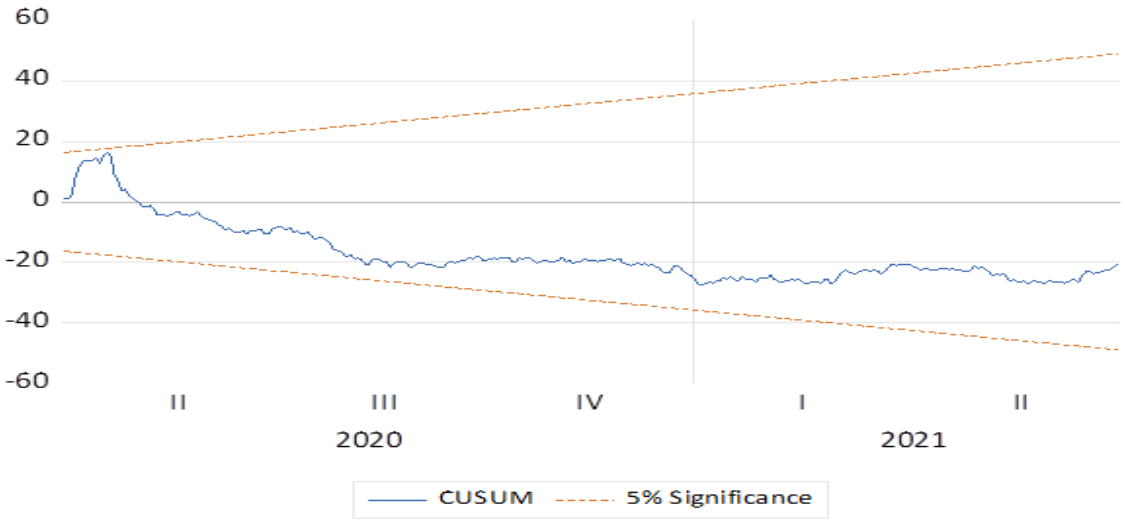

Figure 2. Plot of CUSUM test for parameter stability Covid-19 and Exchange-rate

Conclusion

Understanding the intricate dynamics influencing Morocco's currency exchange rate amid the unparalleled challenges posed by the COVID-19 pandemic holds significant importance. This study employs the Autoregressive Distributed Lag (ARDL) approach, an econometric technique, to delve into the effects of the COVID-19 crisis on Morocco's exchange rate. Significant insights emerged regarding the factors impacting Morocco's exchange rate against the U.S. dollar. It was observed that a rise in the number of new COVID-19 cases had a negative effect on Morocco's exchange rate. This suggests that as the COVID-19 infection rate increased, market concerns about the country's economic stability mounted, resulting in a potential depreciation of the Moroccan currency relative to the U.S. dollar. Additionally, the Brent oil price index, closely linked to global oil prices, negatively influenced Morocco's exchange rate. Fluctuations or declines in oil prices, as represented by the Brent index, have adverse consequences for the country's exchange rate. Given the significance of oil in international trade and its impact on Morocco's economy, such negative effects could be expected. These findings emphasize the interplay between COVID-19 cases, oil prices, and exchange rates in shaping Morocco's economic conditions during the pandemic. They underscore the importance of monitoring and understanding these relationships to navigate the challenges of external and internal factors in a globalized economic context.

The study extends the existing literature by offering a nuanced analysis of the intricate relationship between pandemic-induced shocks and the currency exchange rate in Morocco in the short and long run by employing the Autoregressive Distributed Lag (ARDL) approach. Additionally, study's theoretical and contextual contributions are crucial in understanding the effects of the unprecedented global crisis, such as the COVID-19 pandemic, on the behavior of Morocco's currency exchange rate. Moreover, study is Situated within the paradigm of the Black Swan Theory. The Black Swan Theory posits that rare and unforeseen events, such as the COVID-19 pandemic, have profound and unpredictable impacts. By employing the ARDL approach, this study delves deeper into understanding how these unexpected and extreme events reverberate through Morocco's currency market, shedding light on the intricate interplay between pandemic-induced shocks and the currency exchange rate against the us dollar. Consequently, the study not only expands the theoretical underpinnings of exchange rate dynamics during crises but also provides a nuanced understanding of how Black Swan events, as exemplified by the COVID-19 pandemic, impact the behavior of Morocco's currency exchange rate, contributing to a more holistic comprehension of market behavior in uncertainty times. This study serves as a valuable guide for policymakers, economists, and market analysts, offering crucial insights into the resilience and responsiveness of Morocco currency exchange rate to unprecedented external shocks. It thereby plays a vital role in informing policy decisions and strategies for economic stability and resilience in similar global crisis situations.

Based on the insightful findings of this study, we propose several key recommendations for stakeholders in Morocco's economic landscape. These recommendations are aimed at strengthening the country's economic resilience, mitigating risks, and effectively navigating the challenges posed by global crises. Firstly, Morocco should consider diversifying its economic activities to reduce dependency on specific sectors vulnerable to external shocks. This could involve further development of non-traditional industries, fostering innovation, and encouraging small and medium-sized enterprises (SMEs) to ensure a more resilient and dynamic economy. Secondly, policymakers should implement robust risk management

strategies that account for global economic uncertainties. This includes creating contingency plans and financial buffers to cushion the economy during times of crisis. Additionally, enhancing the regulatory framework to monitor and manage financial risks will contribute to economic stability. Thirdly, given the observed impact of oil price fluctuations on the exchange market, Morocco should consider further investments in renewable and sustainable energy sources. This move can reduce the nation's reliance on fossil fuels and insulate the economy from oil price volatility.

Future research endeavors should delve to advance our understanding of the complex interplay between in a globalized economic context. Expand the research scope to encompass a global comparative analysis in emerging market, examining how different countries respond to similar economic challenges. Comparative studies can provide valuable insights into best practices and policy lessons.

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