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Nesrin Özataç · Korhan K. Gökmenoğlu · Daniel Balsalobre Lorente · Nigar Taşpınar · Bezhan Rustamov *Editors*

Global Economic Challenges

6th International Conference on Banking and Finance Perspectives, Cuenca, Spain

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Contents

Hedge Ratio Variation Under Different Energy Market Conditions: New Evidence by Using Quantile–Quantile Approach

Karim Barati, Arshian Sharif, and Korhan K. Gökmenoğlu

Abstract In this research, we investigated the long-run and causal relationships between spot and futures prices of crude oil, natural gas, and gasoline using monthly data and considering the variables' distribution. The quantile co-integration and quantile causality tests provided strong evidence for the long-run and causal relationships among the variables. Furthermore, we examined the optimal hedge ratio (OHR) at different quantiles of the series using the recently developed quantile on the quantile approach. For all three commodities, our results confirmed the asymmetric response of the spot market to the futures market. Furthermore, our findings show that in a bullish market and for a large positive shock, the value of OHR is significantly greater than one. We observed lower fluctuations in the OHR as the maturities of the futures contracts increased. We discuss the policy implications of our research in detail in the Conclusion section.

Keywords Hedge ratio · Energy market · Quantile-on-quantile (QQ) approach · Causality · Futures market

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Introduction

Price movements in the energy market are crucial because energy plays a vital role in the world's economies and human life. The high volatility in energy prices since the 1990s is due to several historical developments, including the deregulation of energy markets, the Asian financial crisis in 1997, and the 2008 global financial crisis (Lien et al., 2016; Lang & Auer, 2019) have increased the need for an appropriate protection strategy. Hedging by using futures contracts makes the problem of "finding an appropriate hedge ratio" vital. In calculating the optimal hedge ratio (OHR), estimations are mostly based on the average (expected) relationship between spot and futures prices. This approach ignores the tail distribution of the variables (Lien et al., 2016; Shrestha et al., 2018). However, the widely documented non-normal distribution of financial variables makes considering the quantiles of the variables essential. To fill this gap, we used the recently developed quantile-on-quantile (Q-Q) (Sim & Zhou, 2015) approach to estimate the minimum-variance (MV) hedge ratio for crude oil, natural gas, and gasoline markets. Besides, to have a better understanding of the relationship between these variables, we examined long-run and causal relationships by using methods that consider the distribution of the variables.

Crude oil, natural gas, and gasoline are the major energy market commodities. Crude oil is one of the most strategic resources which has substantial effects on many macroeconomic variables, including economic growth (Cheng et al., 2019; Gupta & Banerjee, 2019; Wang et al., 2019; Wang & Wang, 2019), currency fluctuations, and inflation (Lang & Auer, 2019). Due to its high energy density and relatively more convenient transportation, it has been the primary energy source for many industries. The energy used for transportation has been satisfied in large with petroleum products. Besides, it is a raw material for many other products (Wang & Wang, 2019). Although crude oil remains the most critical energy source, the ever-increasing concerns about environmental degradation have enhanced natural gas's importance as a cleaner alternative (Li et al., 2019; Lin et al., 2019). The US has used thirty trillion cubic feet (TCF) of natural gas in 2018, which equals 31% of total US primary energy consumption. It is an important energy source for electric power generation, industry, residential use, and transportation (Energy Information Administration [EIA], 2019a, b). Gasoline is the most consumed petroleum product in the US, with 392 million gallons per day, equal to about 45% of total US petroleum consumption (EIA, 2019a, b).

The significant role of these energy commodities makes their price fluctuations quite essential. Many factors, such as natural disasters, extraction costs, inventory costs, exchange rates, geopolitical instability, climate change, and military conflicts, can cause significant volatility in energy prices. Energy price fluctuations can have substantial impacts on the global economy, and even they may lead to economic and political instability (Wu & Zhang, 2014; Zhang et al., 2015; Billio et al., 2018; Lang & Auer, 2019). Hence, it is essential to hedge in the energy market (Shrestha et al., 2018; Halkos & Tsirivis, 2019).

Futures contracts are among the most important financial instruments, with 17.15 billion trades globally in 2018. A notable feature of the futures market is that it is where price discovery takes place. Futures contracts are widely used to hedge against energy price volatility because of their useful characteristics such as low transaction costs, high liquidity, low counterparty risk, and low margin requirements. Determining the optimal number of futures positions be held to reduce the risk associated with spot price fluctuations is one of the most critical challenges in hedging and has been widely discussed in the theoretical and empirical literature.

There is a complex linkage between spot and futures prices. The spot market may react asymmetrically to the changes in the futures market. For instance, futures price shocks may have different effects on the spot market, depending on whether the spot market is bearish or bullish. Besides, the impact of a large futures price shock on the spot market may differ from that of a smaller shock. Also, spot prices may respond asymmetrically to adverse versus positive futures price shocks. The effect of futures price shocks on the spot market may vary depending on the market conditions, the nature, and the magnitude of the shocks; thus, it is heterogeneous. These asymmetric impacts may cause diverse co-movement behaviors or conditional covariance among spot and futures prices (Meneu & Torro, 2003; Chang et al., 2010b). Therefore, while investigating the spot-futures market relationship to consider the potential non-linear characteristics is a necessity. The complicated relationship between the spot and futures market also affects the OHR as well. This implies that the OHR may vary depending on the factors mentioned above. Hence, conventional frameworks, like OLS, are not suitable to determine the OHR. Although comparatively more recent approaches have some desirable characteristics than OLS, they cannot capture the overall dependence structure.

In this study, we investigated the relationship between spot and futures prices for three major energy commodities. Our research contributes to the literature in several ways. While exploring the cointegration and causal relationship, literature mostly ignores the distribution of the variables and focuses on the average relationship. We employed quantile cointegration (Xiao, 2009) and quantile Granger causality tests to have a better understanding of the relationship between the energy market spot and futures prices by considering the distribution of these variables. In the OHR investigation, choices of the appropriate objective function and methodology are vital. Regarding the first issue, following Lien et al. (2016) and Shrestha et al. (2018), we employed the MV hedge ratio. Regarding the second issue, considering the previous literature's deficiencies, we engaged the recently developed QQ approach (Sim & Zhou, 2015) to uncover state-dependent OHR variations under different market conditions. The OHR has many advantages over the other methods employed in the literature. This model is an amalgam of quantile regression and nonparametric estimation techniques and enables us to regress each quantile of spot returns against the entire distribution of futures returns (Gupta et al., 2018; Han et al., 2019; Mallick et al., 2019; Mo et al., 2019; Shahzad et al., 2019). Hence, it can capture a non-linear relationship and provides dynamic OHR throughout the entire distribution of spot and futures prices. The QQ approach enables us to provide a more inclusive measure of the relationship between spot and futures prices

for three major energy commodities considering the performance of the markets and the sign and size of these shocks. These findings can be used to establish more efficient hedging strategies. We also examined the effect of time on the maturity of the futures contract on the OHR, which provides valuable information for portfolio managers.

The rest of the study includes the literature review, data, methodology, empirical findings, and conclusion.

Literature Review

Discovering the OHR for futures contracts has been one of the most discussed areas in the finance literature. Regarding the discovery of the OHR, two strands of studies have been mainly considered in the literature. The first group of studies aims to discover the OHR based on different objective functions. Reducing the volatility of the hedged portfolio; increasing the expected utility of the hedged portfolio, minimizing the mean extended-Gini (MEG), minimizing the generalized semivariance (GSV), and minimizing the Value-at-Risk (VaR) are examples of different objective functions that have been discussed in exploring the OHR (Shalit, 1995; De Jong et al., 1997; Lien & Tse, 2000; Hung et al., 2006). The performance of each of these objective functions has been tested extensively.

Among several objective functions, the most popular one has been the MV hedge ratio. Many researchers documented the desirable characteristics of the MV hedge ratio (Johnson, 1960; Ederington & Salas, 2008). This approach is based on minimizing the variance of the hedged portfolio and is quite simple to understand and estimate. To derive the MV hedge ratio, the underlying commodity spot returns are regressed on futures returns, where the slope coefficient represents the MV hedge ratio (Ederington, 1979). MV is the most widely used hedging strategy in the literature (Hung et al., 2011; Cotter & Hanly, 2015; Turner & Lim, 2015; Wang et al., 2015; Markopoulou et al., 2016; Park & Shi, 2017; Chun et al., 2019; Wang et al., 2019). Due to its desirable properties and wide use in the literature, we used the MV hedge ratio as our objective function.

The second group of studies aims to discover the OHR by using different models. Early literature claimed that the slope coefficient in OLS regression is the OHR (Johnson, 1960; Stein, 1961; Ederington, 1979). Although the conventional ordinary least squares (OLS) has been the most widely used method, it ignores several problems such as long-term relationship (cointegration), conditional heteroscedasticity, and the time-varying structure of the hedge portfolio. Due to the OLS method's insufficiency, later, to solve the specified problems, many other econometric methods have been employed in the estimation of OHR. The methods that have been used to discover the hedge ratio includes constant conditional correlation (CCC), dynamic conditional correlation (DCC) (Lanza et al., 2006), diagonal BEKK (Chang et al., 2010b), bivariate error correction framework with a GARCH error structure (Kroner & Sultan, 1993), VARMA-GARCH, VARMA asymmetric

(Manera et al., 2006), regime-switching GARCH (Hung et al., 2011), and Bayesian multi-chain Markov switching GARCH (Billio et al., 2018). These studies have contradictory claims on the performance of the econometric methods employed. For example, Chang et al. (2010b) stated that the CCC-GARCH model is superior to the other multivariate GARCH frameworks; however, Chang et al. (2011) found that the performance of multivariate GARCH models is better in exploring the OHR.

In the conventional regression framework, the central focus is on the nexus between spot market returns and futures market returns on average to get the OHR, which leaves us with no information about the changes in hedge ratio at various quantiles of the distributions of the two variables (Shrestha et al., 2018). Although, until recently, many different methods were used to estimate the OHR, none of them targets the mentioned fundamental problem and is not flexible enough to provide a complete picture of the relationship among the variables under investigation. Chang et al. (2010b) found that the OHR might be different for different market states, which calls for taking different market states into account while analyzing the OHR. Lien et al. (2016) proposed a linear conditional quantile model that estimates different hedge ratios for different quantiles of spot returns, which is named the quantile hedge ratio. They found that OHR depends on various quantiles like upper and lower tails of spot returns distribution.

Many studies have investigated the OHR for energy market commodities. Some researchers argued that the OHR between spot and futures prices might depend on several factors such as the holding period of the hedger, maturity of the futures contract, and price discovery level. Chen et al. (1987) analyzed the differences in hedging effectiveness with different holding periods and maturities. They found that the longer hedger's horizon and nearer futures contract maturity lead to a more effective hedging strategy for crude oil, leaded gasoline, and heating oil. Conlon and Cotter (2013) demonstrated that as the hedging horizon increases, hedging effectiveness increases in the heating oil market. They also revealed that hedging effectiveness is not sensitive to different objective functions. However, until recently, researchers did not consider the effect of the market state on the OHR.

Several studies related to the energy market have recently utilized quantile regression (Reboredo & Ugolini, 2016; Zhu et al., 2016; Khalifa et al., 2017). In their recent research, Shrestha et al. (2018) applied the method of Lien et al. (2016) to the energy market. They found that the quantile hedge ratio has an inverted U-shape for crude oil and heating oil. Besides, they discovered that OHR could vary according to the level of price discovery in the futures market. Their findings confirmed the idea that the hedge ratio strongly depends on the different spot market states for crude oil, heating oil, and natural gas. However, there is still one area of study that is neglected, in which the effects of various futures market conditions on the OHR have not been explored in the hedge ratio literature annals. In this study, we extended the literature on the exploration of hedge ratios with the use of a new method proposed by Sim and Zhou (2015), referred to as the QQ approach, which allows us to investigate in detail the variation of hedge ratio in different quantiles of spot and future returns simultaneously.

Data

We used monthly data covering the periods February 1986 to March 2019 for crude oil, February 1997 to March 2019 for natural gas, and January 2006 to March 2019 for gasoline. Cushing, OK crude oil 1, 2, 3, and 4 months' future contracts (Dollars per Barrel), Natural Gas 1, 2, 3, and 4 months' futures contracts (Dollars per Million Btu) and New York Harbor Reformulated RBOB Gasoline 1, 2, 3, and 4 months' future contracts (Dollars per Gallon) were used as proxies for oil, natural gas, and gasoline futures prices, respectively. For spot prices of these commodities, we used Cushing, OK WTI Spot Price FOB (Dollars per Barrel), Henry Hub Natural Gas Spot Price (Dollars per Million Btu), and Los Angeles Reformulated RBOB Regular Gasoline Spot Price (Dollars per Gallon) as proxies. We collected data from Independent Statistics & Analysis US Energy Information Administration database and converted them into logarithmic form.

We report the descriptive statistics of the variables in Table 1. Skewness and kurtosis are far from 0 and 3, respectively, which indicate the skewed distribution and fat tails. These are typical characteristics of much financial time series. A notable finding in Table 1 is the results of the Jarque-Bera (Jarque and Bera, 1980) test, which reveals the non-normality of all of the variables. These findings indicate the benefit of using the QQ method to investigate the relationship between spot and futures prices.

To investigate the stochastic properties of our variables, we applied the Augmented Dickey-Fuller (ADF) (Dickey & Fuller, 1979) unit root test. To confirm our findings, we also employed Zivot and Andrews (ZA) (Zivot & Andrews, 1992)

Table 1 Descriptive statistics

Variables	Mean	Minimum	Maximum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability
OIL	0.002	−0.394	0.392	0.087	−0.449	5.622	127.414	0.000
Futures-1	0.002	−0.396	0.377	0.087	−0.443	5.453	112.848	0.000
Futures-2	0.002	−0.353	0.320	0.081	−0.505	5.084	88.911	0.000
Futures-3	0.002	−0.326	0.283	0.077	−0.564	5.014	88.369	0.000
Futures-4	0.003	−0.307	0.263	0.073	−0.620	5.017	92.968	0.000
NGAS	−0.001	−0.473	0.478	0.134	−0.003	4.357	20.420	0.000
Futures-1	0.000	−0.396	0.406	0.121	0.030	3.752	6.305	0.043
Futures-2	0.000	−0.377	0.362	0.113	0.019	3.538	16.254	0.000
Futures-3	0.001	−0.372	0.296	0.104	0.020	3.473	22.496	0.000
Futures-4	0.001	−0.231	0.256	0.089	0.020	3.068	29.069	0.000
RBOB	0.001	−0.516	0.454	0.119	−0.295	6.301	74.489	0.000
Futures-1	0.001	−0.384	0.353	0.102	−0.554	5.126	38.082	0.000
Futures-2	0.001	−0.364	0.284	0.095	−0.798	5.001	43.420	0.000
Futures-3	0.001	−0.342	0.212	0.088	−0.842	4.885	42.305	0.000
Futures-4	0.000	−0.332	0.245	0.082	−0.803	5.081	45.770	0.000

Source: Author estimations

Table 2 Results of unit root tests

Variables	ADF (level)	ADF (Δ)	ZA (level)	Break period	ZA (Δ)	Break period
OIL	−0.382	−6.483***	−1.283	2006 M02	−9.493***	2008 M08
Futures-1	−1.042	−9.723***	−1.958	2010 M10	−11.592***	2011 M01
Futures-2	−1.583	−6.402***	−2.495	2015 M03	−10.583***	2015 M03
Futures-3	0.258	−5.763***	−0.522	2010 M02	−7.448***	2010 M02
Futures-4	0.781	−7.535***	0.854	2012 M11	−10.421***	2012 M11
NGAS	0.876	−5.321***	−2.471	2009 M07	−12.581***	2005 M05
Futures-1	−1.294	−5.631***	−1.448	2004 M07	−8.664***	2011 M07
Futures-2	−0.993	−3.491***	−1.341	2013 M12	−9.315***	2017 M09
Futures-3	−0.251	−9.597***	−0.472	2007 M05	−6.942***	2019 M01
Futures-4	−1.335	−7.625***	−1.003	2005 M11	−8.593***	2016 M05
RBOB	−2.044	−4.592***	−2.045	2016 M10	−10.615***	2009 M07
Futures-1	−1.448	−3.842***	−1.753	2009 M03	−11.374***	2011 M04
Futures-2	−0.921	−6.414***	0.515	2013 M01	−9.329***	2018 M06
Futures-3	−0.337	−6.097***	0.994	2007 M08	−8.624***	2015 M10
Futures-4	1.475	−5.669***	−0.551	2017 M04	−9.553***	2008 M12

Note: The values in the table specify the test statists of the ADF and ZA tests
The asterisk ***, **, and * represent the significance level at 1%, 5%, and 10%, respectively

unit root test, which incorporates one endogenous structural break. Table 2 illustrates the results of these unit root tests. Both ADF and ZA unit root tests indicate that the natural logarithm of oil, natural gas, and gasoline and four futures contracts returns series are not stationary at their levels, while the first difference forms of all these variables are stationary. This finding requires the investigation of the cointegrating relationship between the variables.

Methodology

We further examined the long-run relationship among the variables using the quantile cointegration model developed by Xiao (2009). This model can capture the variation of quantile coefficients. To create the critical values, we used 1000 Monte Carlo simulations. We also used 19 equal quantiles from 0.05 to 0.95 to find the test statistic of the quantile cointegration model. Furthermore, to test the causality among variables' conditional distributions, hence, to check whether the information regarding the relationships between variables could help the decision-making process, the Granger causality test (Granger, 1969) was incorporated.

We used the QQ approach (Sim & Zhou, 2015), which enables one to examine the effect of quantiles of the explanatory variable on the quantiles of the other variable, thus providing more comprehensive information compared to conventional models. The QQ approach generalizes the standard quantile regression method (Koenker & Bassett, 1978). More specifically, it is a combination of quantile

regression and nonparametric estimations. First, quantile regression is used to find the effects of the independent variable on the quantiles of the dependent variable. Second, local linear regression (Stone, 1977; Cleveland, 1979) is utilized to find a linear regression locally around the neighborhood of each data point in the sample by giving more weights to closer neighbors.

We start with the following nonparametric quantile regression equation:

$$\text{Spot}_t = \beta^{\theta}\left(\text{Futures}_t\right) + U_t^{\theta} \tag{1}$$

where Spot_t denotes the spot market returns of a given commodity in period t, Futures_t represents the futures market returns for that commodity in period t, θ is the θth quantile of the conditional distribution of the spot returns, and U_t^{θ} is a quantile error term whose conditional θth quantile is equal to zero. $\beta^{\theta}(.)$ is an unknown function because we have no prior information about the nexus between spot and futures returns.

Although quantile regression enables us to explore the varying effects of futures market returns on conditional quantiles of spot market returns, it doesn't consider the effects of quantiles of futures returns on spot returns. Hence, it doesn't provide information about the relationship between spot and futures returns when there are largely positive or negative shocks in the futures market that may also affect the OHR. To capture the relationship between the θth quantile of spot returns and τth quantile of the futures returns represented by Futures^{τ}, Eq. (1) is examined in the neighborhood of the Futures^{τ} by utilizing the local linear regression. We can expand $\beta^{\theta}(.)$ with the first-order Taylor expansion around a quantile of Futures^{τ} with the help of the following equation:

$$\beta^{\theta}\left(\text{Futures}_t\right) \approx \beta^{\theta}\left(\text{Futures}^{\tau}\right) + \beta^{\theta\prime}\left(\text{Futures}^{\tau}\right)\left(\text{Futures}_t - \text{Futures}^{\tau}\right) \tag{2}$$

where $\beta^{\theta\prime}$ is the partial derivative of β^{θ} (Futures_t) with respect to Futures, which is the marginal response. This coefficient has a similar interpretation as the slope coefficient in a linear regression framework. The main feature of Eq. (2) is that it considers both θ and τ as doubled indexed parameters that are illustrated as $\beta^{\theta}(\text{Futures}^{\tau})$ and $\beta^{\theta\prime}(\text{Futures}^{\tau})$. Moreover, $\beta^{\theta}(\text{Futures}^{\tau})$ and $\beta^{\theta\prime}(\text{Futures}^{\tau})$ are both functions of θ and Futures^{τ}, and Futures^{τ} is a function of τ. Thus $\beta^{\theta}(\text{Futures}^{\tau})$ and $\beta^{\theta\prime}(\text{Futures}^{\tau})$ are both functions of θ and τ. It is also possible to rename $\beta^{\theta}(\text{Futures}^{\tau})$ and $\beta^{\theta\prime}(\text{Futures}^{\tau})$ as $\beta_0(\theta,\tau)$ and $\beta_1(\theta,\tau)$, respectively. Based on that, the modified version of eq. (2) can be rewritten as:

$$\beta^{\theta}\left(\text{Futures}_t\right) \approx \beta_0\left(\theta,\tau\right) + \beta_1\left(\theta,\tau\right)\left(\text{Futures}_t - \text{Futures}^{\tau}\right) \tag{3}$$

We derive Eq. (4) by substituting Eq. (3) in Eq. (1):

$$\text{Spot}_t = b_0\left(q,t\right) + b_1\left(q,t\right)\left(\text{Futures}_t - \text{Futures}_t\right) + U_t^{q} \tag{4}$$

(*)

The part (*) in eq. (4) represents the θth conditional quantile of the spot returns. However, since β_0 and β_1 are dual indexed in θ and τ, (*) shows the relationship between the θ quantile of spot returns and τ quantile of futures returns. Next, Futures_t and Futures^{τ} need to be replaced by their estimated counterparts $\widehat{\text{Futures}}_t$ and $\widehat{\text{Futures}}^{\tau}$ in Eq. (4) so that the local linear regression estimation of the parameters β_0 and β_1, which are b_0 and b_1 can be obtained through minimizing the following equation:

$$\min_{b0,b1} \sum_{n}^{i=1} r_q \left[\text{Spot}_t - b_0 - b_1 \left(\widehat{\text{Futures}}_t - \widehat{\text{Futures}}^{t} \right) \right] \times K \left(\frac{F_n \left(\widehat{\text{Futures}}_t \right) - t}{h} \right) \quad (5)$$

Where ρ_θ is the quantile loss function, interpreted as $\rho_\theta(u) = u(\theta - I(u < 1))$; I is the usual indicator function; $K(.)$ represents the Kernel function, and the parameter h in the denominator is the bandwidth of the Kernel.

To weigh the observations in the neighborhood of Futures^{τ}, we used the Gaussian Kernel function. Gaussian Kernel is symmetric around zero and therefore assigns the least weights to observations farther away. Moreover, there is an inverse relationship between these weights and the distance of the observations among the distribution function of $\widehat{\text{Futures}}_t$ defined by:

$$F_n \left(\widehat{\text{Futures}}_t \right) = \frac{1}{n} \sum_{n}^{k=1} I \left(\widehat{\text{Futures}}_k < \widehat{\text{Futures}}_t \right)$$

and eventually generates the value from the distribution function corresponding to the Futures^{τ}, representing as τ.

The bandwidth parameter in Kernel function is one of the most important factors as it represents the size of the neighborhood around the target point in which choosing a large number for h can lead to estimation bias, and a small number can generate a greater variance in our estimation. In this study, we set the bandwidth parameter as $h = 0.09$.

Empirical Findings

In Table 3, the results of the quantile cointegration are reported. Tabulated results confirm the long-run relationship between oil, natural gas, and gasoline spot and four futures contract returns. Therefore, they show that the variations among the coefficients vary throughout the quantiles of the variables. The critical values generated by 1000 Monte Carlo simulations in which CV1, CV5, and CV10 are the critical values for the significance level of 0.01, 0.05, and 0.1, respectively.

We provide the Quantile Granger Causality test results in Table 4. Probability values for the test statistics indicate that for all these energy market commodities,

Table 3 Quantile cointegration test results

Model	Coeff.	$\text{Sup}_\tau \mid V_n(\tau) \mid$	CV1	CV5	CV10
OIL vs. *Futures (OIL)*					
OIL_t vs. Futures-1_t	β	4831.288***	3715.224	3089.316	2831.001
	γ	1537.026***	1102.441	896.315	715.308
OIL_t vs. Futures-2_t	β	59,463.215***	46,318.157	34,361.058	23,135.251
	γ	18,302.088***	16,328.048	13,841.554	10,846.213
OIL_t vs. Futures-3_t	β	3460.587***	2893.046	2147.315	1836.149
	γ	1635.548***	1205.687	951.089	831.356
OIL_t vs. Futures-4_t	β	230.006*	349.010	239.887	133.041
	γ	143.353*	259.703	155.975	105.115
NGAS vs. *Futures (NGAS)*					
NGAS_t vs. Futures-1_t	β	2974.368***	2204.007	1346.648	593.872
	γ	1815.187***	1345.054	821.828	362.426
NGAS_t vs. Futures-2_t	β	3089.004***	2288.952	1398.550	616.760
	γ	1189.146***	881.157	538.387	237.429
NGAS_t vs. Futures-3_t	β	4899.108***	3630.239	2218.076	978.172
	γ	1960.387***	1452.647	887.567	391.417
NGAS_t vs. Futures-4_t	β	6571.316***	4869.345	2975.170	1312.050
	γ	2502.894***	1854.644	1133.188	499.736
RBOB vs. *Futures (RBOB)*					
RBOB_t vs. Futures-1_t	β	7328.842***	5430.672	3318.141	1463.300
	γ	4472.620***	3314.212	2024.984	893.018
RBOB_t vs. Futures-2_t	β	7611.305***	5639.978	3446.026	1519.698
	γ	2930.055***	2171.171	1326.586	585.024
RBOB_t vs. Futures-3_t	β	12,071.402***	8944.909	5465.339	2410.215
	γ	4830.393***	3579.322	2186.966	964.452
RBOB_t vs. Futures-4_t	β	16191.722**	19,998.066	7330.819	3232.891
	γ	6167.130**	7569.844	2792.175	1231.349

Note: This table presents the results of the quantile cointegration test of Xiao (2009) for the logarithm of the Oil price, natural gas, gasoline, and all proxies of the Futures market. CV1, CV5, and CV10 are the critical values of statistical significance at 1%, 5%, and 10%, respectively. We use 1000 Monte Carlo simulations to generate critical values. We use an equally spaced grid of 19 quantiles, [0.05–0.95], to calculate the test statistic of the quantile cointegration model

there is bidirectional Granger causality between the spot market and 1, 2, 3, and 4 months' futures contracts. This finding is relevant for all the quantiles, which shows that the relationship between spot and futures returns is persistent for each point of the distribution of the variables. Hence, it is possible to employ the data for the spot (futures) market to make better predictions about the futures (spot) returns. Either upward or downward movements in spot returns and futures returns promulgate the movements in each other.

Figure 1a–l illustrates the QQ relationship and estimates the slope coefficient $\beta_1(\theta, \tau)$, which captures the effect of futures τth quantile return on the θth quantile return of the spots at different values of τ and θ of three energy market commodities under investigation. Four exciting results emerged from the figures. First, all the

Table 4 Results of Granger Causality in quantiles

Quantiles	[0.05–0.95]	0.05	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	0.95
$\Delta OIL_t \rightarrow \Delta FUT1_t$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\Delta OIL_t \leftarrow \Delta FUT1_t$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\Delta OIL_t \rightarrow \Delta FUT2_t$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\Delta OIL_t \leftarrow \Delta FUT2_t$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\Delta OIL_t \rightarrow \Delta FUT3_t$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\Delta OIL_t \leftarrow \Delta FUT3_t$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\Delta OIL_t \rightarrow \Delta FUT4_t$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\Delta OIL_t \leftarrow \Delta FUT4_t$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\Delta NGAS_t \rightarrow \Delta FUT1_t$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\Delta NGAS_t \leftarrow \Delta FUT1_t$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\Delta NGAS_t \rightarrow \Delta FUT2_t$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\Delta NGAS_t \leftarrow \Delta FUT2_t$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\Delta NGAS_t \rightarrow \Delta FUT3_t$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\Delta NGAS_t \leftarrow \Delta FUT3_t$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\Delta NGAS_t \rightarrow \Delta FUT4_t$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\Delta NGAS_t \leftarrow \Delta FUT4_t$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\Delta RBOB_t \rightarrow \Delta FUT1_t$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\Delta RBOB_t \leftarrow \Delta FUT1_t$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\Delta RBOB_t \rightarrow \Delta FUT2_t$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\Delta RBOB_t \leftarrow \Delta FUT2_t$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\Delta RBOB_t \rightarrow \Delta FUT3_t$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\Delta RBOB_t \leftarrow \Delta FUT3_t$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\Delta RBOB_t \rightarrow \Delta FUT4_t$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\Delta RBOB_t \leftarrow \Delta FUT4_t$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Source: Authors' estimation

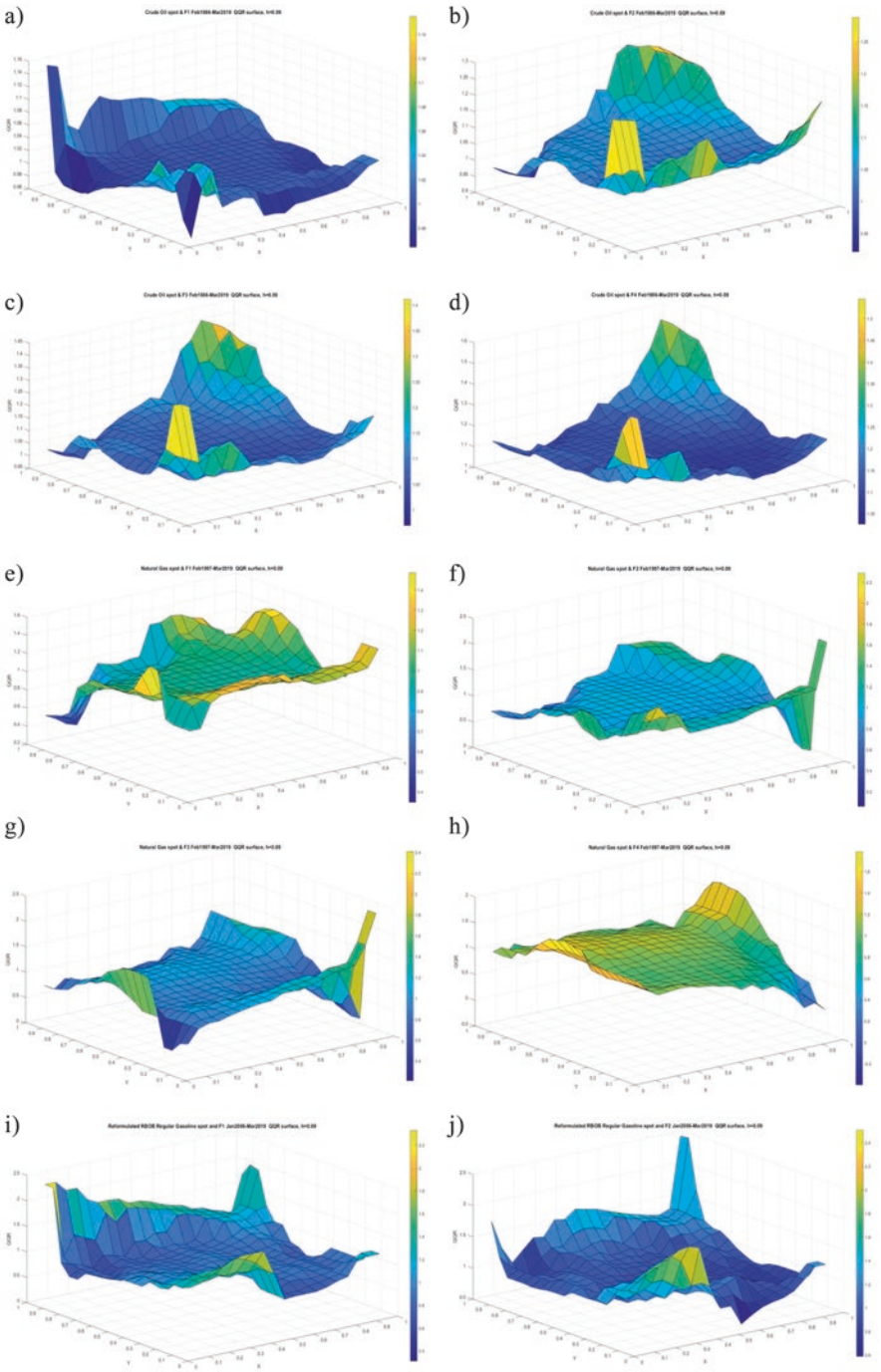

Fig. 1 Quantile-on-Quantile 3-D surface view

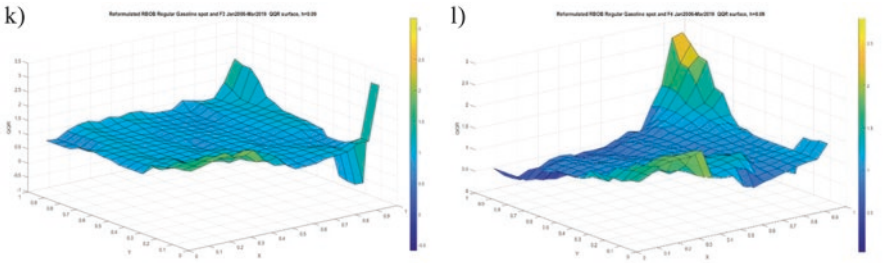

Fig. 1.1 (continued)

figures show a positive relationship for the entire quantiles of spot and futures returns for all commodities. This result is consistent with the positive nexus between spot and futures market that has been documented by the prior literature, and it sheds light on the fact that the futures market plays a vital role in price discovery (Shrestha, 2014; Chang & Lee, 2015; Shrestha et al., 2018). Second, we observed heterogeneity across crude oil, gasoline, and natural gas regarding the association between spot and futures returns. Third, there are considerable variations in the OHR across the distributions of spot and futures returns for all three commodities. This result suggests that across quantiles, the relationship between spot and futures return is not uniform, but this relationship depends on the size and sign of futures market shocks and, at the same time, the particular states of the spot market. Additionally, we found the most variations of the OHR for three commodities at the highest and the lowest quantiles of the spot and futures returns distributions, that is, when there are extreme events in the spot and futures market. Finally, as the time to maturity in futures contracts increases, the fluctuations in the OHR decrease considerably. The mentioned result shows that a three to four-month time span is enough for spot prices to converge to future prices, and the new information is reflected in the crude oil, natural gas, and gasoline market.

Among the three commodities investigated, we observed the lowest variation in the OHR for the natural gas market. Figure 1e–h shows the results generated from the QQ approach for natural gas spot returns and 1, 2, 3, and 4 months' futures returns, respectively. We found positive and close to one OHR for medium quantiles (the central points of the distributions) for both variable distributions for all maturities of futures contracts. However, the OHR tends to strengthen or weaken at the highest or lowest quantiles of the spot and futures returns. For instance, the OHR is significantly lower than one at the highest quantiles (0.7–0.9) of the spot and lowest quantiles (0.1–0.2) of the futures market. The results are the opposite at low quantiles (0.1–0.2) of the spot and high quantiles (0.7–0.9) of the futures market. The OHR is significantly higher than one at high quantiles of both spot and futures returns (0.7–0.9), which corresponds to the bullish spot market and a futures market that experienced a large positive shock. Finally, natural gas graphs became smoother as we shift from one-month time to maturity to four-months' time to maturity.

In the case of crude oil, Fig. 1a–d illustrates spot returns distributions for 1, 2, 3, and 4 months' futures returns, respectively. The OHR is positive and close to one for the combination of medium quantiles (0.4–0.6) of both variables. Nevertheless, we

observed a significant variation in the OHR at the extreme quantiles. More precisely, we found that the OHR is higher than one at the lowest quantiles (0.1–0.3) of both spot and futures returns, that is, when the spot market is bearish and when there is a large negative shock in the futures market. However, we observed notably low values of the OHR in the area that combines high quantiles of spot returns (0.7–0.9) with low quantiles of futures returns (0.1–0.3). The OHR is higher than one at relatively low quantiles of spot returns (0.1–0.3) and high tails of futures returns (0.8–0.9). The highest value of the OHR was found at intermediate to high quantiles (0.6–0.9) of both spot and futures returns, which corresponds to the combination of a bullish spot market and positive shock in the futures market. Again, as we move from 1 month to maturity futures contracts to longer maturities, we observe smoother changes and a lower OHR variation for crude oil.

For gasoline, Fig. 1i–l shows that high variation in the OHR is mostly at the highest and lowest quantiles of the spot and futures returns. Similar to the natural gas and crude oil graphs, the OHR for the gasoline market is close to one when the spot and futures market condition is normal; which is, at medium quantiles of spot and futures returns (0.4–0.6). The changes in the OHR are more prominent at higher quantiles. We observed that the OHR is significantly higher than one at the intermediate to upper quantiles of both variables (0.7–0.9). In the case of a bearish spot market (0.1–0.3) and large adverse shocks in the futures market (0.1–0.3), the OHR is higher than one, but not as strong as the highest quantiles of both variables. At the high tails of the spot (0.7–0.9) and low tails of futures returns (0.1–0.3), OHR is higher. However, this effect flattens out as the time to maturity of the futures contract gets longer. These results indicate that the hedging strategy should be adjusted according to the change in spot market states and whether there are positive or negative shocks in the futures market.

The QQ approach decomposes the findings of the standard quantile regression. In this paper, we regressed the θ quantiles of the spot market returns on the futures market returns using the quantile regression model. Thus, the estimates of the quantile regression parameters are only indexed by the θ. Although, as we mentioned in the methodology part, the QQ approach regresses the θth quantile of the spot returns on the τth quantile of the futures returns. Thus, we can consider θ and τ as indexes for QQ approach parameters. It is possible to recover the estimates of the quantile regression by taking the average of the QQ coefficients along τ. As an example, the slope coefficient of the standard quantile regression method, which captures the effect of futures returns on the distribution of the spot returns and is denoted $\gamma_1(\theta)$ can be generated as follows:

$$\gamma_1(\theta) \equiv \hat{\beta}(\theta) = \frac{1}{S}\sum_{\tau}\hat{\beta}(\theta,\tau)$$

where $S = 19$ is the number of quantiles $\tau = [0.05, 0.10, \ldots, 0.95]$ considered.

In this regard, one way to check the QQ approach's validity is to compare the estimates obtained by taking the averages of the QQ coefficients with those of the standard quantile regression model. Figure 2a–l illustrates that the averaged QQ

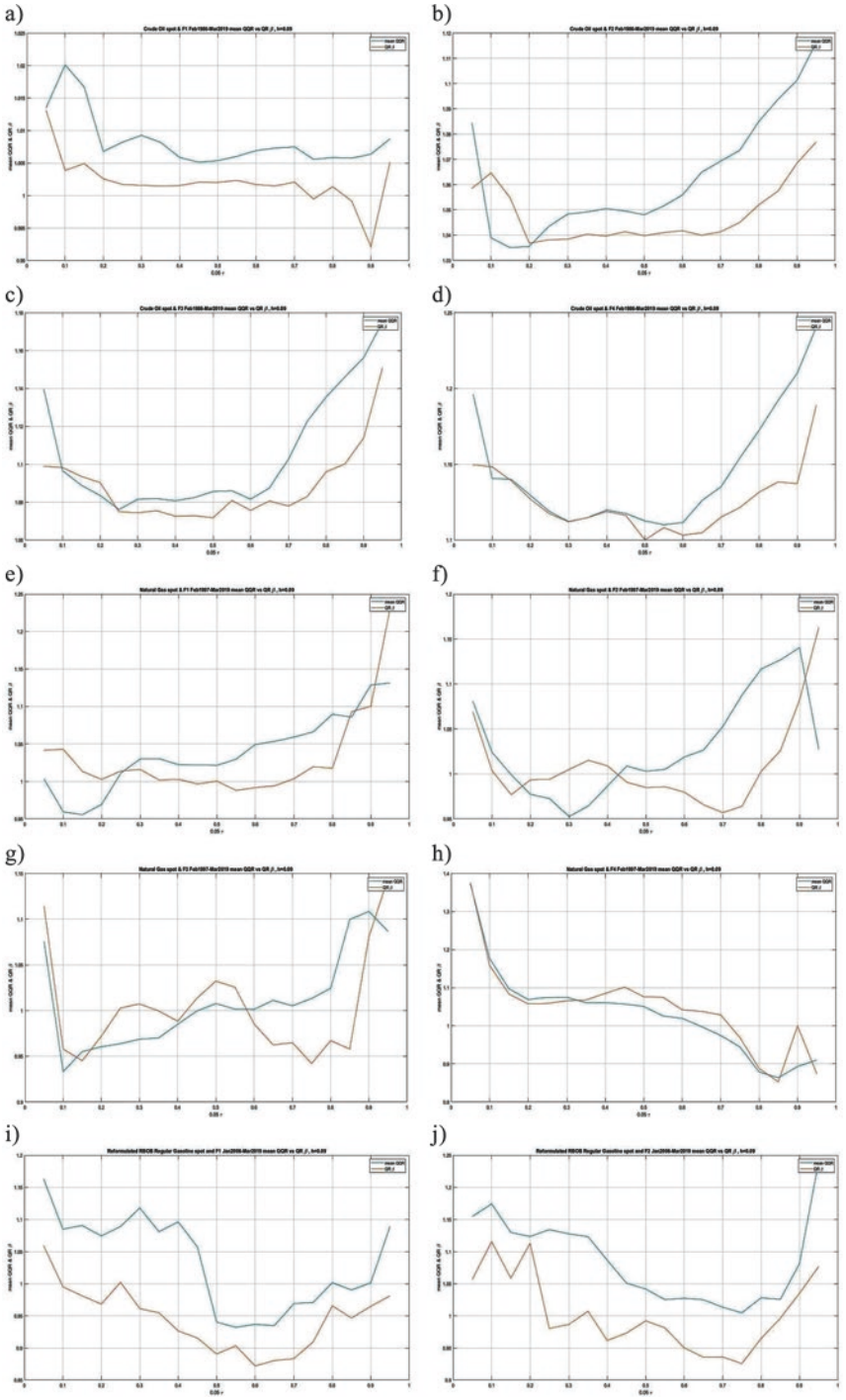

Fig. 2 Comparison of quantile regression and QQ estimates

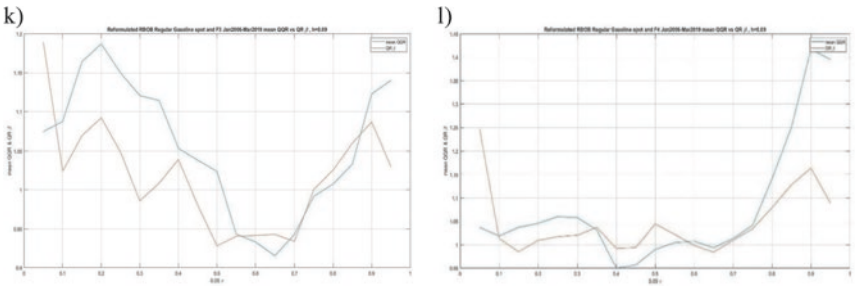

Fig. 1.2 (continued)

estimates and the quantile regression estimates are quite identical for all three variables. Referring to these graphs, we can provide validation for the QQ findings by showing that it is possible to recover the estimates of the quantile regression by taking the averages of the parameters estimated from the QQ approach.

Conclusion and Policy Implications

This study empirically examined the long-run and causal relationship and the OHR between spot and futures prices for crude oil, natural gas, and gasoline. In contrast to most previous empirical studies, we consider the distribution of variables under investigation. Obtained findings confirm the long-run and causal relationship among the variables, although coefficients and significance levels differ among different quantiles of the variables. Our empirical evidence highlights that the OHR can significantly vary across the distribution of spot and futures prices. According to the results, the OHR is higher than the one-to-one naive hedge ratio at high quantiles of both spot and futures prices for all three commodities. Obtained findings also confirmed the decrease in the OHR variation as the time to maturity in futures contracts increased from 1 month to 4 months. This result indicates that 4 months is long enough for spot prices to reflect the new information in the futures market.

Our findings indicate that hedging strategy should be calibrated due to the change in spot market states and when there are positive or negative shocks in the futures market. The findings of this study are valuable for policymakers, portfolio managers, and companies. These agents should know the variation of the OHR at different spot and futures market conditions such as bullish, bearish, contango, and backwardation and also at the entire market distributions for a more efficient diversification and policy formation. The empirical results are beneficial for portfolio managers as they provide clear and comprehensive information about the linkage between spot and futures prices so that managers can reduce the risk associated with the portfolio under management using futures contracts. In particular, energy market companies can take advantage of our findings through the pattern of dynamic hedge ratios among spot and futures prices. During the different market states, they need

to follow dynamic hedging strategies and change their positions accordingly. In the case of practitioners involved in the energy market, it is crucial to know how to modify their derivatives market positions to avoid adverse price movements. They should consider that for the shorter time to maturities, the hedge ratio is significantly dependent on the quantiles of both spot and futures prices. However, this dependency flattens out for longer futures contract maturities such as 3 and 4 months. For instance, during the extreme spot market condition, and when there is a large positive shock in the futures market, they need to increase their short position in the futures market compared with their commodity holding. Furthermore, policymakers can benefit from this study, as our results show the critical role of the futures market in price discovery. However, this role can vary according to the change in the commodity.

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The Use of AI in Metaverse

Yavuz Selim Balcıoğlu, Melike Artar, and Oya Erdil

Abstract The benefits of the technological advances developing with the Internet are constantly increasing recently. These developments, which have grown at almost the speed of light, have made it convenient for users to leave the real world and live in the virtual world. The first phase of this breakthrough started with introducing social networks into our lives. There are many services and applications in this sector. The second phase brought by social networks over users has been virtual environments and virtual game worlds. At this point, the term metaverse, which is a combination of the words meta and universe, has emerged. Apart from the word's meaning, it refers to a virtual environment shared by more than one person. The development of technologies has occurred in terms of the increasing number or quality of applications and artificial intelligence; serious developments are taking place today. In this study, in addition to the artificial intelligence applications and topics taking place in the metaverse universe, research has been done on the artificial intelligence theories that are predicted to be realized as a concept.

Keywords Metaverse · Environment · Artificial intelligence

Introduction

In the 1990s and beyond, when the Internet was revolutionized, various innovative technologies were created to provide users with breathtaking experiences in cyberspace with more virtual interaction. With the development of the Internet over the years, the rapid prevalence of new communication technologies in daily life allows many new concepts to be included in our lives (Lee et al., 2021). Today, the virtual environment offers hundreds of services, from virtual games to social media platforms. The concept of the metaverse is a good example that can be given of these concepts and phenomena lately (Ning et al., 2021).

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Facebook acquired the Oculus company in 2012, investing in and developing this technology. At the same time, it has decided to establish a large virtual platform to bring together all the digital universes used and produced related to augmented reality (AR) and virtual reality (VR). While Facebook changed its name to Meta, it announced the name of this great platform that it had been willing to establish as Metaverse (Dionisio et al., 2013).

When we look at the use of the word metaverse, it is seen that this concept, which has become popular today, was used for the first time 30 years ago. The prefix 'meta' in Ancient Greek means 'beyond' and 'after'. "Verse" is derived from the word "universe" meaning universe. The concept of the metaverse is expressed as "cyberspace" in William Gibson's science fiction novel "Neuromancer" published in 1984 (Kshetri, 2022). However, the closest use of the meaning of Metaverse is in Neal Stephenson's dystopian science fiction novel "Snow Crash" written in 1992. In the novel, Metaverse is defined as a virtual medium where users can enter, socialize, work, study, visit friends, travel, play games, and shop with AR and VR glasses. Today, Metaverse aims to create a universe where digital worlds merge in just such an environment (Kim, 2021).

Metaverse takes these visualization technologies to another dimension by combining these visualization technologies on the blockchain infrastructure and also by providing artificial intelligence support, it is accepted as a new Internet application integrating various new technologies, so it is social, and it is positioned as the next form of media. Metaverse, which aims to immerse users in digital items on screens, seems to have the potential to change not only social media concepts but also our lives, relationships, behaviors, and even our physiology (Kye et al., 2021).

The use of AI in the Metaverse is significant and seen as the next step in human evolution. Its importance can be proved by its presence in many science fictions, such as the matrix. Many people see artificial intelligence as the way to move forward for humanity (Ning et al., 2021). It will take care of repetitive and complicated tasks for humans to do manually, such as managing databases, or it can even generate new ideas and solutions that humans never thought about.

Although the Metaverse was first brought to the agenda by Facebook, big technology companies such as Google and Microsoft have been making significant efforts to develop their Metaverses for a long time. While technology companies design their metaverses, commercial companies design stores and develop products suitable for these metaverse universes (Lee et al., 2021). As we see the large-scale investments made by the world's leading companies in the Metaverse universes, it is possible to say that the Metaverse universes will occupy a larger place in our lives in the future compared to today. Beyond simulating real life, all these preparations initiated by big players from different sectors will offer important innovations and opportunities in the metaverse environment, which is a whole of digital universes where what cannot be done in real life can be done (Kye et al., 2021).

New communication technologies and environments draw us into these new fictional universes. This universe, whose influence we feel intensely in every aspect of life, is trying to create a new world from scratch in all vital areas from economy to working life, from entertainment to culture and art. This study focuses on the

meaning of the concept of a metaverse in general terms and in which areas artificial intelligence will be used in the metaverse.

Literature Review

Metaverse

Metaverse means that users communicate in the virtual world, similar to the physical world. With the use of technologies such as blockchain, augmented reality, and virtual reality, it is the creation of a digital world in which objects, environments, avatars, and events in the Metaverse universe are designed to approach the physical world experience (Dionisio et al., 2013).

Metaverse, which emerges as a new communication technology, expresses a fictional universe in which all digital structures are combined. Although the metaverse seems to be conceptually a phenomenon obtained from the combination of real and virtual, it would be more accurate to approach this concept in detail in terms of scope. Unreal or intangible will come to mind first when a discussion arises about what exactly is the superuniverse (Kye et al., 2021). However, although this interpretation seems meaningful at first glance, it is actually insufficient in terms of the scope of the subject. Because the metaverse, which positions itself between the real and the virtual, shows a tendency that receives support from both universes. The state of being, in reality, brings with it the feeling of being in the virtual environment and becoming embodied.

The best example that can be given to this sense of existence is provided by the VR (virtual reality) glasses, which are widely used nowadays and worn on the head. Or, by creating virtual representations of your own in the metaverse environment, you can say "I'm in" in certain areas and leave your virtual fingerprint in the virtual universe. You can interact in the digital environment with your avatar that you have created for yourself, and you can find a place for yourself in a universe that is always open and unlimited (Kim, 2021).

The Metaverse has three main aspects. These are: presence, interoperability, and standardization. Presence is the feeling of being in a virtual space with other individuals, of being embodied. Interoperability is the ability to seamlessly travel between sandboxes with the same virtual assets, such as avatars and digital assets. Standardization is to ensure the interoperability of platforms and services in the metaverse (Lee et al., 2021). Kshetri (2022) states that the transition to the three-dimensional virtual network or metaverse of the metaverse is possible in four areas. These four areas are an immersive reality; ubiquitous access and identification, interoperability, and scalability become possible. In realism, it is important to determine whether the virtual space is realistic enough for users to feel psychologically and emotionally immersed in the alternative space. Being ubiquitous is expressed as the continuity of the user's ability to access the virtual spaces that make up the

metaverse with all available digital devices and virtual identities of the user. Interoperability refers to the smooth operation of virtual environments and the integration of systems with each other. Scalability also focuses on whether the Internet server provides enough power to enable larger-scale servers (Gadekallu et al., 2022).

In the study by Lee et al., it is stated that in the context of new generation technologies such as 5G, systems such as human–computer interaction, artificial intelligence, blockchain, computer vision, Internet of things, and cloud computing create the metaverse ecosystem. For the usage areas of Metaverse, Kye et al. (2021) focus on how metaverse is used in advertising. Kim (2021) focuses on how the metaverse can integrate the virtual and the real on three-dimensional software, emphasizing that the phenomenon can develop in the context of "hyper-reality." Again, it is possible to say that there are studies in which the metaverse is explained through three-dimensional software in current studies. At the same time, Ning et al. (2021) focus on new ecosystems in the service provision of metadata warehouses regarding existence in the metaverse universe in real time. Nguyen (2022) presents case studies and virtual training suggestions on how virtual and real worlds can work randomly through these ecosystems. Narin (2021), on the other hand, made certain models about how to synchronize the Internet of Things (IoT) and data in order to make the metaverse more effective with their study named "A Dynamic Resource Allocation Framework for Synchronizing Metaverse with IoT Service and Data." Bolger (2021) states that the three-dimensional world (3D) creates three-dimensional (3C; Communities, Creativity, Commerce) communities, creativity, and commerce in the metaverse universe. Gadekallu et al. (2022) also focused on three-dimensional social virtual worlds, and through examples related to virtual commercial environments, it was commercially important that the money flow in this environment continued despite the virtual environment.

With the spread of the metaverse universe, new business opportunities and employment opportunities for individuals will emerge. For example, studies are continuing on the participation of disabled people in the workforce thanks to augmented reality (XR) technology (Kye et al., 2021). With these advanced technologies, disabled individuals will freely create their avatars in the metaverse universe and participate in business life. The value of the metaverse world, which plans to provide employment, is increasing day by day. In this context, according to the research of Bloomberg Intelligence, the global metaverse revenue in 2020 is 500 billion dollars. This revenue is expected to increase to US$ 800 billion in 2024 (Kshetri, 2022).

In addition to the services Metaverse offers to users, it is sold at significant prices in virtual spaces. Last year, Metaverse Group bought a parcel on the virtual reality platform known as Decentraland for $2.43 million. This has been determined as the highest price in virtual real estate. In addition to Metaverse Group, Activision Blizzard, the video game company of Microsoft, aims to improve its games and offer new experiences to its users in the meta world. Activision Blizzard has signed a game development deal for $68.7 billion to improve its services and enter the meta world. In addition, some internationally famous artists buy land from the metaverse world at high prices to give their concerts. This rapid development of the meta world

has attracted the attention of Internet finance businesses, online game makers, and other technology leaders.

In this study, Shen et al. (2021) propose a vision for the Metaverse of tomorrow where AI and blockchain enable digital assets to have real-world value. Also, they present a survey of the metaverse describing its components, an AI-powered digital world that merges the real and virtual worlds. Summarizes the latest research and technologies that aim to enable AI, Blockchain, and cryptocurrencies to interact and have real-world applications (Shen et al., 2021).

Nguyen (2022) reviews the areas where machine learning can be applied to IoT, e.g., device classification and security, data analytics, event handling and algorithm selection, and monitoring of network status to predict performance and reliability. This paper introduces an overview of recent developments in the blockchain IoT domain using artificial intelligence. They describe potential IoT–blockchain convergence in the near future and provide some implications and possible challenges of IoT blockchain on AI.

Mozumder et al. proposed a digital medical hub utilizing leading technologies to develop a medical care exchange and create incentives for clinicians, patients, developers, and the industry, creating digital value across the pharmaceutical, biotech, and medical device industries. It shows the potential use of Metaverse blockchain in medical industries and promotes innovative solutions that modern medicine can benefit from (Bolger, 2021).

In this study, Kshetri (2022) proposes a roadmap and future research roadmap for the metaverse based on the author's visit to Second Life, investments in the metaverse, university campuses, and a blockchain-based metaverse. They introduce a three-layer metaverse architecture, including infrastructure, interaction, and ecosystem.

Kye et al. (2021) provide a definition of the metaverse and a discussion of the potential of VR in education, as well as a discussion of potential barriers that may hinder its adoption. They suggest how AI can be used to create tools that empower teachers to collaborate with each other and provide more customized educational experiences.

In the last few years, developments in hardware and software have enabled the virtual world to be built in a more real way. Apart from virtual structures and spaces created in the virtual world, digital products, objects, and created virtual identities can switch between different virtual environments and even be reflected in the real world (Kim, 2021). It offers a more immersive experience than traditional metaverse methods by using a number of techniques such as natural language processing, neural interface and computer vision through artificial intelligence.

Metaverse and AI

Kemp and Livingstone, in their work, provide information about computer tools commonly called Virtual Environments (VE). VEs allow participants in multiple locations to share a virtual space and interact using various sensory modes.

Interaction takes place through audio, text, graphics, movement, and touch. A survey of educators interested in using VEs for teaching finds that most teachers are motivated by the educational possibilities of the various senses offered through VEs. Finally, they present a case study that uses Second Life as an exemplar (Kemp & Livingstone, 2006).

Dionisio et al. show that the Metaverse is an overarching term for a "virtual universe" composed of many virtual worlds, created using software and hardware from H.P. and Oculus. This evolution from connected 3D virtual worlds relies on hardware (H.P. Z V.R. Backpack) improvements and software (viewport). To bring about this functionality, the industry has to navigate four "regions": Virtual Worlds, Identity & Interoperability, Realism, and Scalability (Dionisio et al., 2013).

Mozumder et al., in their paper, Metaverse, are utilizing an approach in which a substantial number of disparate devices and machines, whether mobile or fixed, can be linked together, forming a sizeable networked computing environment that shares typical IoT, Blockchain, and Artificial Intelligence technologies. Metaverse aims to bring the convenience and efficiency of such IoT platforms and other Blockchain technologies to the public to provide people with a second online home (Mozumder et al., 2022).

Jeon et al. show that blockchain and artificial intelligence are closely related to technology development. In the virtual world in which COVID-19 is distributed, new technology is being used daily to change how we see the world. Artificial intelligence and blockchain technologies combine intelligence and leadership in virtual reality. The article is about how A.I. can be implemented in the virtual reality we know today, improving our present lifestyles (Jeon et al., 2022).

AI Applications

The future of technology is often spoken about in terms of artificial intelligence (AI) and robots. It's no secret that AI and robots are becoming more and more advanced, and they're starting to play a more significant role in our lives. This vision is becoming increasingly a reality with the development of Artificial Intelligence (AI) and other cutting-edge technologies. There are many elements in the metaverse universe. They work directly or indirectly together with artificial intelligence technology. It is shown in detail in Fig. 1.

There are already several companies working on creating the Metaverse. Some of the most notable include Magic Leap, Oculus, and Microsoft. The Metaverse will likely be built on existing platforms such as the Internet, but it will be a completely immersive experience.

In this study, theories about the application processes of artificial intelligence applications in the Metaverse world are explained. There are four types of leading ideas. These are: Business Communication, Immersive sales, Online Education, and Blockchain Applications.

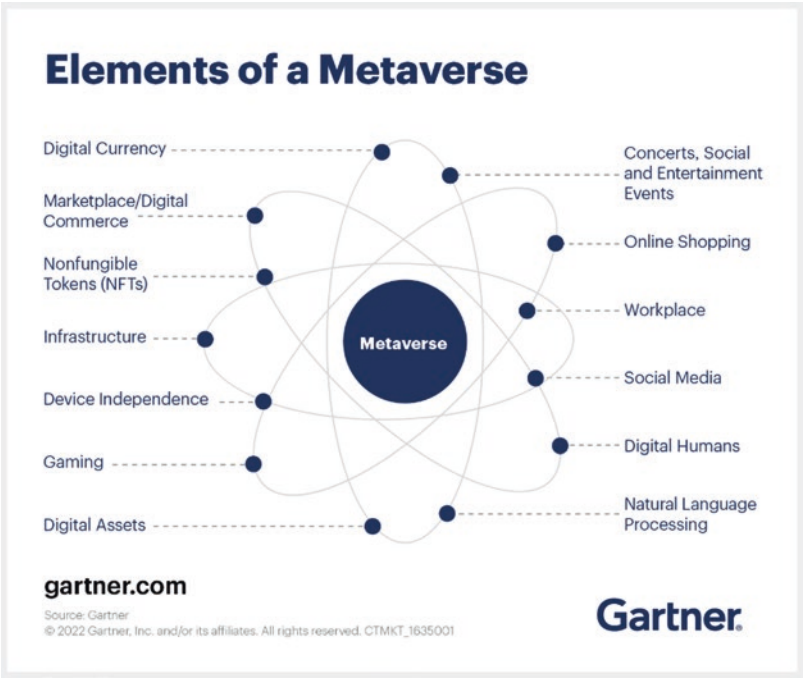

Fig. 1 Elements of a Metaverse. (From Gartner.com)

Business Communication

Metaverse will transform the corporate communication landscape by implementing upcoming technologies that enable businesses to communicate more intimately and at a deeper level. Since existing communication platforms are designed as legacy software, they are inadequate for collaboration purposes and cannot capture the organic energy and energy of the participants involved (Kshetri, 2022).

Metaverse will usher in the future of communication, where users will be able to exchange holographic images in real-time like an actual business meeting. For example, you could have a full-scale hologram of another person seated in front of you and speaking with you as they would in person. This could apply to residential and commercial spaces as well. In addition, guests would be able to tour empty spaces with walk-throughs and video interaction with physical components without actually visiting in person (Kim, 2021).

The developed AI technology can help business communication by overcoming language barriers or be used for universal language processing. For example, the technology can process the business requirements and then provide the business documents in the target language that connects to the right target audience. It also helps executives from companies to better understand and access foreign markets, cultures, and customers.

Immersive Sales

Virtual billboards and ads on highways and expressways are significantly impacting the sales process, and many businesses are getting themselves featured in virtual ads. The entire sales and marketing process will witness a fantastic transformation that will accelerate business growth. Imagine virtual hoarding seen by millions of users or avatars in real time and businesses spending money to acquire rights to those advertisement spaces! This is no more fiction, as inventors buy metaverse real estate and strengthen their virtual assets for monetization. These opportunities for sales and marketing through the Internet have increased significantly since 2010 (Shen et al., 2021).

There will be a significant change in how we distribute and consume marketing content due to the creation of the Metaverse. With data points such as physical location, preferences, and customer history, the brand will be able to communicate products and services in a much more advanced manner than ever before. As a result, every user will get content specific to their needs, thereby significantly increasing the chances of success for the business.

Research in this area will radically alter the retail experience. The creation of virtual shops and physically realistic 3D merchandise models will provide unprecedented access to products for customers. Searching for a specific product or comparing different models and styles is easier. This Metaverse will enable personalized shopping where the customer can add in their preferences. The possibilities are endless, from grabbing a pair of jeans from the virtual mall and using them as a virtual fitting room in your living room to easily comparing book selections.

Online Education

Metaverse is an education platform that allows users to form their digital avatars and take real classes from real professors and teachers, who may even include their friends from social networks or the big education providers like Khan Academy or Coursera. Most importantly, students will benefit from visually stunning learning aids that help them understand concepts and theories in unprecedented depth. Furthermore, they will be able to interact with other students directly in the classroom via digital aids.

Contrary to the 2D online courses of today, Metaverse will offer 3D systems, in which users can interact using their digital avatars. Instead of staring at images, users can participate in interactive activities by tinkering with virtual circuit boards or sending each other messages on interactive whiteboards. Using the same technology, students may even attend lectures from professors who don't teach remotely.

Education has a rich history of innovation and progress, yet unfortunately, its benefits are often unreachable by various populations due to the high costs of quality education. Online teaching platforms provide an excellent method for delivering

instruction. Still, due to high costs and a lack of quality control and oversight, much of what is available online does not adequately meet the population's needs. This study will outline the benefits and challenges of expanding the availability of online education, with a vision toward online virtual.

Blockchain Applications

Blockchain is one of the core technologies that spawned cryptocurrencies, the Internet of things (IoT), and other decentralized digital platforms. Blockchain enables the development of Non-fungible tokens (NFTs), a prime feature of virtual reality games and secure identification (Gadekallu et al., 2022). These capabilities allow the construction of cross-chain trading platforms, enabling a new class of digital assets and Metaverse, parallel virtual universes to evolve in diverse yet interlinked and intricate ways.

Blockchain can make cryptocurrencies much more potent due to the high power of its open-source nature, in which data and resources are shared in a peer-to-peer network (Nguyen, 2022). With blockchain technology, transactions are recorded on an immutable ledger available to anyone who participates in the network without requiring centralized financial intermediaries or other third parties. All information is recorded chronologically and is transparently accessible to all network participants. Furthermore, records are secure against tampering and revision, as they are cryptographically protected.

The growing complexity of real-world issues and lack of trust, transparency, and security in data transmission are holding the mass adoption of AI back. This project aims to utilize blockchain technology to address the trust and data transmission issues and make them transparent so they can be dealt with; hence, it can help bring AI closer to the world.

Conclusion

In the past decades, Artificial Intelligence has been developed in many sectors. However, its application in virtual reality is still new. The use of AI in the Metaverse has recently attracted much attention due to its ability to increase our lives' efficiency and output quality. Metaverse is still at an early stage of development. Still, if it can be used as a digital platform like mobile apps, it will profoundly change our digital interactions and consumption patterns. Companies, government agencies, and NGOs will try to leverage the possibilities of this new environment in multiple areas, including customer support, sales and marketing, employee engagement/engagement, training, public relations, and more. AI is embedded in Metaverse as an intelligent agent that could execute tasks according to the user's needs and requirements using technology such as neural networks and deep learning.

Artificial intelligence (AI) is changing our daily lives. And as an increasing number of different industries adopt AI, it is essential to keep pace with the capabilities and limits of artificial intelligence. We believe that this research will make a difference by creating a better understanding of how AI can be used to improve daily lives and work. In addition, it will help developers use AI more efficiently and build better products.

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What Proportion of the Bitcoin Ecosystem Is Controlled by Bots?

Yavuz Selim Balcıoğlu and Gökhan Özer

Abstract Its proponents argue that Bitcoin allows for disruption of how money transfers are made. They also claim that Bitcoin is less susceptible to fraud than money because the BTC balance cannot be duplicated and used by another person. Its critics claim it is a bubble because of its high volatility and the number of security breaches. People who create bitcoin or other cryptocurrencies care because the use of bots means their technology is less trusted and valuable. Also, people who sell assets that rely on Bitcoin price stability (such as bitcoin futures and options) care because bot activity can cause price fluctuations and financial losses. This research aims to study how to control and regulate the influence of Bitcoin bots. Our market analysis reveals unusual trading recently that was most likely triggered by some significant event. This finding is consistent with our extensive robustness checks.

Keywords Bitcoin · Ecosystem · Bots

Introduction

Bitcoin is a cryptocurrency (a form of digital money) invented in 2009 by a mysterious person who used the pseudonym Satoshi Nakamoto (Chohan, 2017). It is a decentralized currency, meaning that any government or central bank does not issue it. Instead, it relies on computers worldwide to process transactions and remain secure through cryptography. Its proponents argue that Bitcoin allows for disruption of how money transfers are made. They also claim that Bitcoin is less susceptible to fraud than money because the BTC balance cannot be duplicated and used by another person (Beattie, 2020).

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On the other hand, its critics claim it is a bubble because of its high volatility and many security breaches. Cryptocurrency has been getting more attention recently, as its price has increased substantially over the past year. People who create bitcoin or other cryptocurrencies care because using bots means their technology is less trusted and valuable. Also, People who sell assets that rely on Bitcoin price stability (such as bitcoin futures and options) care because bot activity can cause price fluctuations and financial losses. This research aims to study how to control and regulate the influence of Bitcoin bots. Our market analysis reveals unusual trading recently that was most likely triggered by some significant event. This finding is consistent with our extensive robustness checks.

Bitcoin is one of the biggest disruptors to traditional money and currency transfer in the twenty-first century (Rathore, 2020). Despite its recent growth, Bitcoin still acts as the basis for many transactions globally, so it's critical to understand the health of its ecosystem. We focused on whether Bitcoin is vulnerable to fraud or manipulation. To analyze this, we created bots that bought or sold Bitcoin simultaneously on thousands of different exchanges while monitoring prices across decentralized exchanges and storing historical data to discover price trends. The goal was to determine what percentage of Bitcoin supply was controlled by bots, which could potentially be used for nefarious purposes like spoofing market movements or manipulating prices downward when other investors try selling their shares (Fairfield, 2014a). We found that 98%+ of all market volume comes from trading bots, but only ~11% of the total market cap flows through them daily (meaning about $40 billion worth).

The proportion of the Bitcoin ecosystem controlled by bots is considerable since bots manage most transactions (Fairfield, 2014b). For instance, 72% and 80% of all mining pools are composed of pools that use Bitmain's ASIC hardware. Furthermore, the mining pools are split between pools that use other hardware and pools that rent hardware from third parties such as NiceHash. The specific proportion of the Bitcoin ecosystem controlled by bots can be estimated by looking at the number of transactions per second (TPS) for different transactions. For example, there have been about 50,000 transactions per second in the last 24 hours. However, this does not mean that all of these transactions were made with bots: some were made manually, and some were made with other types of software (e.g., miners). Hence if we assume that only 10% of all bitcoin transaction volume is due to human activity, then approximately 90% must come from bot trading or automated trading platforms like Coinbase Pro and BitMEX.This means that at least nine of every ten Bitcoin transactions are not done manually but through some computerized process involving a bot program or API call.

The cryptocurrency market is highly volatile. Most money comes from trading bots only interested in short-term profits and can manipulate prices down when other investors try selling their shares (Mirtaheri et al., 2021). Trading bots are predatory and can drive prices down when other investors try to sell their shares. Given the extreme volatility of the cryptocurrency market, simple logic dictates that gains and losses are usually more significant than those in more stable markets. Tradition dictates that investors should not invest more than they can afford to lose.

The Bitcoin blockchain is a public ledger that records bitcoin transactions. It is implemented as a chain of blocks, each block containing a hash of the previous block up to the genesis block of the chain. A network of communicating nodes running bitcoin software maintains the blockchain. Transaction data is permanently recorded in files called blocks. They can be thought of as the individual pages of a city recorder's recordbook (where changes to title to real estate are recorded) or a stock transaction ledger. Blocks are organized into a linear sequence over time (also known as the blockchain).

In this paper, we examine how bots affect the prices of Bitcoin on Mt. Gox, which is a leading bitcoin exchange (Takemoto & Knight, 2014). The results are consistent with the existing literature that investors trade on news and information. However, our trading activity analysis shows that bots play a significant role in causing market volatility. The most influential trading platforms are those operated by significant hedge funds or financial institutions such as Goldman Sachs, HSBC, UBS AG, Bank of America Merrill Lynch (BofA-ML), Barclays Capital Inc., etc.

Related Works

Gandal et al. demonstrate that there was abnormal trading activity on Mt. Gox in late 2013 that drove the BTC-USD exchange rate from around $150 to over $1000 over 2 months. This shows how an unusual trading activity caused a 600,000 BTC transfer of value on the Mt. Gox currency exchange, a now-defunct Bitcoin trading platform, which led to rapid currency appreciation. Also, it determines the impact of suspicious Bitcoin trading activity on the Mt. Gox exchange rate through statistical analysis and asserts that trading likely caused the dramatic exchange rate increase. Lee et al. propose a chatbot that provides information about blockchain and cryptocurrency, analyzing trust in the Bot and confidence in blockchain applications. Sward et al. present arbitrary data injection techniques for bitcoin's blockchain and compares them according to 11 dimensions. Krafft et al. demonstrate the ability of bots on crypto exchanges to exert significant influence over the value of cryptocurrencies and the human traders buying them. It uses experimental trading bots and machine learning to understand how traders interact and the social influence effects in the cryptocurrency ecosystem (Gandal et al., 2018).

Chen et al. propose a method for identifying large-scale market manipulation schemes in the cryptocurrency market by analyzing the transaction history of the Mt. Gox exchange. They show that many cryptocurrency networks are correlated with Mt. Gox's price, and accounts in those networks have market manipulation patterns, suggesting that there was market manipulation going on in Mt. Gox during the time it operated. Analyzes the manipulation patterns of large-scale market manipulation using an approach of financial transaction network analysis (Chen et al., 2019).

Hu et al. analyze orders placed on the Gemini exchange from 2016 to 2019 and finds market manipulation. They find that ~99.92% of bitcoin trades are executed as

limit orders, contrary to the popular narrative of a decentralized currency. Furthermore, their work shows that during the 2017 bubble, market orders increased dramatically, contradicting the claim that bitcoin is immune to market influence (Hu et al., 2022).

Fratric et al. proposed a model to examine systemic risk in cryptocurrency markets by simulating Bitcoin market activity, analyzing empirical data, and comparing model predictions to actual data. Their work shows how an agent-based simulation of a market with various agents engaged in different trading strategies can be used to identify suspicious trading patterns and document the role of an active manipulative agent. Furthermore, they used an agent-based model to study how market manipulation works and found that manipulating the price reduced volume trading in the asset (Fratric et al., 2022).

Bot System

Program trading, also known as algorithmic trading, is a computer-based method of placing orders to trade securities used in the financial markets. It uses preprogrammed trading instructions, accounting for variables such as time, price, and volume. These instructions are known as algorithms.

In the equities world, different kinds of bots have become common nowadays. One type of Bot welcomed in the equities market is the high-frequency trader (HFT). HFT is a bot that provides liquidity to regular buyers and sellers of equities. However, bots are not always identical in cryptocurrency, and some bots are not there to help you.

Bots are ubiquitous; nowadays, you can find them in every corner of the equities market. Some traders welcome bots that function as liquidity providers to their orders, allowing them to execute them faster. However, the cryptocurrency world is more complicated since many trading bots exist. Some of them are just used for manipulating the price of a cryptocurrency by buying and selling a coin with preprogrammed algorithms.

Manipulating Cryptocurrencies by Bots

Bots are used for automated trading in traditional financial markets, for example, the stock market. A bot can be developed independently or purchased online. But the main difference between cryptocurrency and traditional financial markets is that cryptocurrency exchanges are not regulated by any regulatory body, providing scope for large-scale manipulation.

The market was manipulated by a bot that purposefully acted against Virgil's algorithm. The Bot tracked the rates of a cryptocurrency on different exchanges. It bought it where the rate was lower and sold it where it was higher. At that time, Virgil tracked the rates once a minute, but within a few seconds before checking

again, the Bot began to place an order for the sale of Etherium at a price lower than other sellers, forcing Virgil to try to purchase from him. This Bot is similar to spoofing – when traders make false orders to cancel them. This tactic allows you to create the impression that the supply or demand for an asset is more significant than it is. In 2010, the United States declared it illegal in the stock and futures markets.

Manipulation takes the form of "pump and dump." For example, a trader convinces other market participants to buy a cryptocurrency, increasing its rate. And then the trader sells it. As a result, it makes a profit, and investors who purchased the cryptocurrency at the peak suffer losses. Such a scheme is considered fraudulent and is prohibited in stock trading.

One of the tools allows traders to place buy and sell orders of the same cryptocurrency back and forth among themselves. Such transactions are considered fictitious in stock and futures markets and are prohibited.

Investigating Methods

The application was made on the buying and selling values of crypto coins that we determined with the data we received from the Coinmarketcap website. In this study, Bot was used at two different operating levels. Figure 1 shows the application settings of the bots. Three different cryptos were used for this study. These are Solano, Cardano, and Cronos, respectively. Both long and short bot methods were bought and sold based on the same period for these three cryptos.

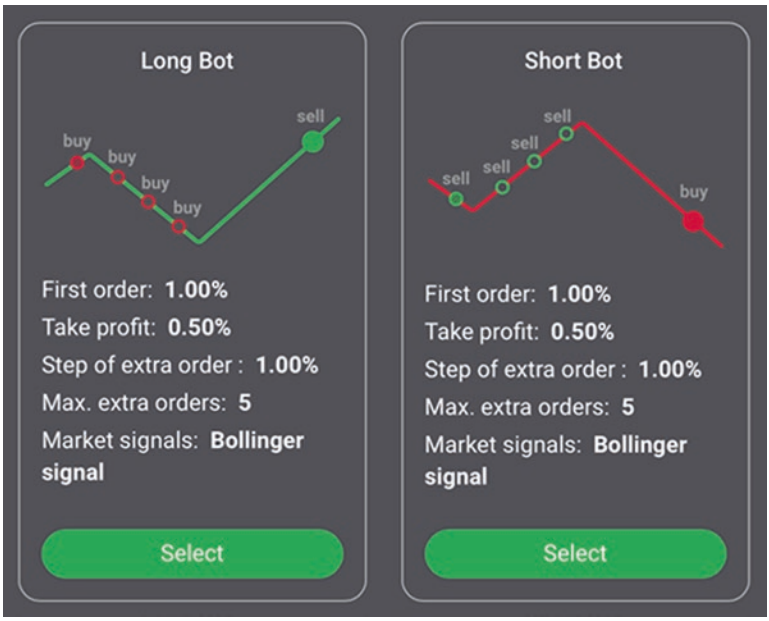

Fig. 1 Two different bot applications

Figure 2 shows the volume and value statistics of the Solano coin. In our study, a three-day data field was marked over 1 month's data of Solano. Over these 3 days, the buying and selling data were examined. In region A, the Solano section has experienced a rise and fall when examined, respectively. However, when the pre-declining volume values are examined, it will be seen in the following B and C regions that a low volume has been realized. In the B region, where the volume figures increased in the last month, the lowest price value of the previous month was obtained. When that day's buying and selling deals are examined on Binance, an artificial perception has been made that the sales figures are intensely entered, and Solano owners sell their coins via bots. Finally, bullishness has increased in zone C, although the volume has dropped, and buying figures have declined. When the buying and selling data on Binance is analyzed in the C region, the bots have opened purchase-based transactions.

Figure 3 shows the volume and value statistics of the Cardano coin. We used the three regions we marked for Solano in Cardano. Over these 3 days, the buying and

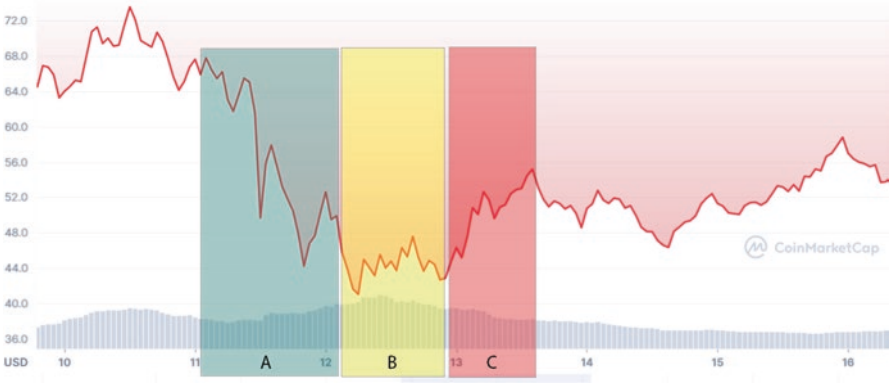

Fig. 2 Representation of the volume and value statistics of Solano

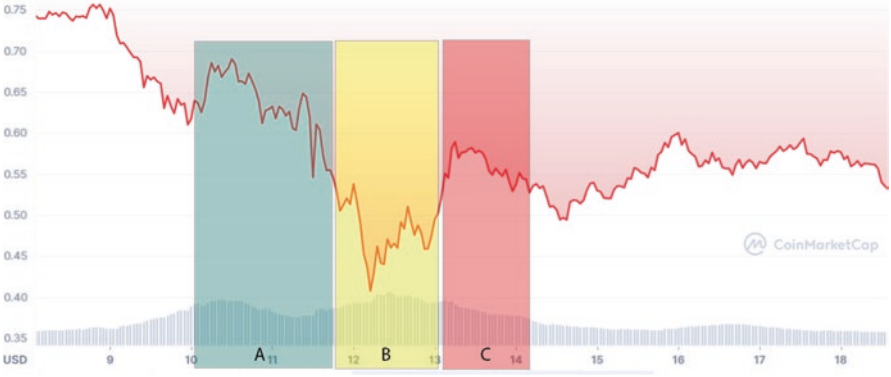

Fig. 3 Display of Cardano's volume and value statistics

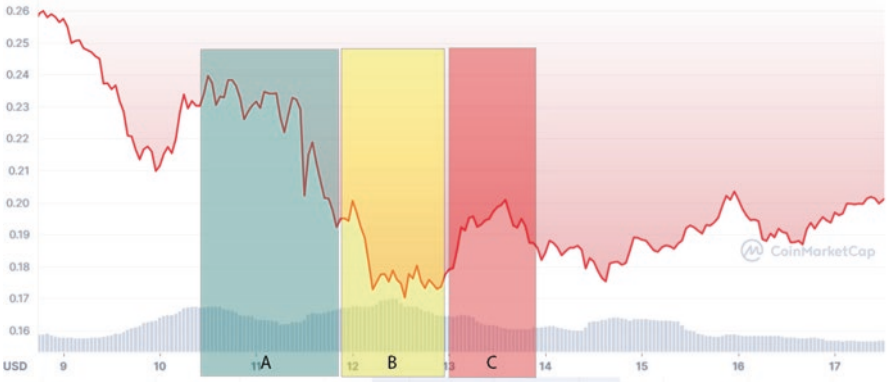

Fig. 4 Representation of the volume and value statistics of Cronos

selling data were examined. When analyzed, it switched from an uptrend to a downtrend in region A. Volume values formed the second-highest peak in the monthly data in this region. The volume figures formed the highest peak in the B region in a month's data. However, it reached the lowest-priced value in this region. This period created the largest pit area in the monthly data. When the buying and selling values of that day are examined on Binance, selling pressure was created by the Bots for Cardano owners to sell the coin in their hands. When the buying and selling data on Binance is analyzed in the C region, the bots have opened purchase-based transactions. An artificial increase in the market has been achieved by creating an artificial purchase by bots.

Figure 4 shows the volume and value statistics of the Cronos coin. We used the three regions we marked for Solano and Cardano in Cronos. Over these 3 days, the buying and selling data were examined. When analyzed, it switched from an uptrend to a downtrend in region A. Volume values formed the second-highest peak in the monthly data in this region. The volume figures started at the highest peak in the B region in a month's data. However, it reached the lowest-priced value in this region. This period created the largest pit area in the monthly data. When the buying and selling values of that day are examined on Binance, selling pressure was created by the Bots for the Cronos owners to sell the coin in their hands. When the buying and selling data on Binance is analyzed in the C region, the bots have opened purchase-based transactions. In zone C, the price value of Cronos has soared, while volume values have hit their lowest levels. In this region, users have been removed from purchases thanks to bots in an uptrend. For this, an artificial sales situation has been created.

Conclusion

When we examine the three popular crypto coins, bot transactions have serious manipulative effects on users and the market, both buying and selling. In this way, it has been determined that the impact of bots in the market is high with users with a high volume of goods.

Due to the increasing number of crypto coins and the increasing demand for them in recent years, there has been a significant increase in the rate of manipulation in this area. One of the reasons for this situation is the increasing number of trading platforms.

Since the Bitcoin ecosystem is unregulated, there are risks for investors and users. For example, if exchanges do not operate correctly, investor funds may not be secure. As a result, regulators worldwide are working to understand the potential implications of virtual currencies so that they can consider policy options. In the USA and Europe, regulators have used two approaches to consider policy responses to virtual currencies: temporary or ongoing monitoring of virtual currency systems and regulation through licensing or registration of organizations participating in virtual currency markets.

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Exploring the Impact of Corporate Social Responsibility on Leverage of Listed Companies in Oman

Afshan Younas and Aza Azlina Md Kassim

Abstract The purpose of this paper is to examine the association between corporate social responsibility (CSR) disclosure and the leverage of Omani non-financial listed companies, using data from the Muscat Securities market (MSM). A fixed-effect regression model is used to examine the relationship between CSR disclosure and leverage among non-financial listed companies of Oman. To measure the CSR disclosure of listed companies, an index has been developed which comprised 40 elements covering all aspects of CSR philanthropy. The paper finds that higher levels of CSR disclosure are associated with lower leverage levels. The relationship between CSR disclosure and leverage shows a strong negative relationship in the context of Omani firms. The paper concludes that CSR disclosure provides balance control to leverage of the public listed companies. This study is conducted to provide evidence of the CSR disclosure impact on leverage in Oman, a country where CSR disclosure is mandatory under corporate governance law and the capital market is still not well developed. This paper's findings provide evidence that CSR disclosure by companies is useful to the board of directors and managers, as it controls the leverage of the firms.

Keywords Corporate social responsibility disclosure · Leverage · Corporate governance · Non-financial companies

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Introduction

After the major scandals of world-famous organizations like Enron and WorldCom, many measures have been taken and attention has been shifted to corporate governance mechanisms. The urgency of corporate governance arises to align the interest of different stakeholders as well as to create a monitoring mechanism(Obradovich & Gill, 2013). Under the corporate governance mechanism, companies are governed and controlled by a planned system (Cadbury Report, 1992).

Corporate governance is an imperative system to reduce agency costs. Similarly, agency theory suggests aligning the interest of different stakeholders and reducing the problem of information asymmetry, which is proven as one of the reasons for many firms' bankruptcy and failure in the past. At the same time, the trend and presence of globalization expect and demand businesses to comply with corporate social responsibility policies and disclosure.

In Oman, the code of corporate governance was first developed and implemented in 2002, which was amended in 2010, and the third and current version of the code of corporate governance was developed in 2015 and implemented in 2016 (CMA, 2016). Corporate social responsibility is the important and thirteenth principle of the code of corporate governance in Oman. According to this principle, the companies are required to develop CSR charter and disclose their CSR activities in their annual reports.

At the same time, the capital market in Oman is not well developed and many publicly listed companies are dependent on banks for debt financing. As there is a high demand for debt, the interest cost is significantly high in Oman as compared to developed countries. In addition, an increase in corporate tax from 2015 also resulted in increased debt levels to get an advantage of the tax shield and maximize the firms' profits. Oman has also reported high leverage levels as compared to neighboring GCC (Gulf Cooperation Council) counties (Bin-Sariman et al., 2016).

Good CSR practices yield many benefits to businesses, including reducing the cost of capital, less information asymmetry, and increases productivity. Managers have better information than outsiders. This information asymmetry has an important impact on CSR because managers know much more about business as compared to the outside world. Managers can increase CSR disclosure and control the leverage level of the company (Razali et al., 2017). High disclosure of corporate social responsibility activities leads to decrease in information asymmetry and resolves agency problems, which further leads to control of the leverage and keeps an optimal capital structure of a business (Xu & Yang, 2019).

This study focuses on the CSR disclosure impact on leverage on publicly listed companies in Oman. An optimal balance between debt and equity is required under the corporate governance mechanism, which also affects the company's financial health of a company (Waworuntu et al., 2014). There are consequences of more debt over capital (Heng & Azrbaijani, 2012). Thus, it is highly required by listed companies to control the leverage levels to avoid bankruptcy.

The findings of the study show that CSR disclosure is significantly negatively associated with leverage in the context of Oman. This study contributes to capital structure and CSR disclosure literature by providing evidence that the level of leverage is relevant to CSR disclosure in such a way that CSR disclosure can be used as a tool to control the leverage. This finding is consistent with the study of Xu and Yang (2019), who also found a negative association between CSR disclosure and leverage. Thus, these findings provide evidence in the context of Oman.

This paper is organized as follows. Section "Prior Literature and Hypothesis" provides an overview of the prior literature that explored the relationship between CSR disclosure and leverage, discusses the theoretical framework, and developed the hypothesis for the current study. Section "Research Methodology" provides the details about the sample, measures of CSR disclosure, and leverage. Section "Results and Findings" presents the results and findings, and finally, Section "Conclusion" focuses on the conclusion.

Prior Literature and Hypothesis

CSR Disclosure and Leverage

Since Modigliani and Miller (1958), many authors have tried to understand the determinants of capital structure (Modigliani & Miller, 1958). The literature about the determinants of capital structure is mainly dominated by two competing theories, the trade-off theory, and the pecking-order theory. The trade-off theory assumes that the existence of an optimal capital structure reflects a trade-off between the cost and benefit associated with debt and equity (Jensen & Meckling, 1976). The cost and benefit exist in the form of tax benefits of debt and non-debt tax shields. At the same time, debts are considered a means of giving higher responsibility to managers. Under this scenario, debt benefits are thus related to the reduction of agency problems. Whereas pecking-order theory presumes that information asymmetry between investors and managers is the most imperative driver for firms' financing decisions (Pijourlet, 2016). This information asymmetry leads to a preference for debt over equity. Whereas CSR disclosure helps to reduce leverage.

The higher CSR disclosure firms usually face lower capital limitations due to several reasons. First, superior CSR performance and disclosure is linked to better engagement with stakeholder and limiting short-term behavior (El Ghoul et al., 2011). Second, firms with higher CSR disclosure signal long-term focus, differentiate themselves, and increase transparency around the social and environmental effects of companies and their governance structure (Dhaliwal et al., 2011). Thus, the qualitative and increased availability of CSR disclosure reduces information asymmetry between a firm and its investors (Beiting et al., 2012).

The concept of CSR was officially introduced by Howard Bowen in 1953 and is considered the father of the CSR notion (Diez-Cañamero et al., 2020). The CSR

notion has been transformed from the beginning till now. The introduction of several aspects of CSR makes the term broader and thus there is no specific definition (Latapí Agudelo et al., 2019). Several businesses follow CSR as a form of self-regulation system to reduce the impact of information asymmetry, while several countries consider CSR as a part of laws and mandatory regulation (Jamali & Mirshak, 2007).

Another important consideration in CSR literature is its measurement of CSR disclosure as it enables stakeholders to improve their decisions as investors, customers, lenders, managers as well as regulators (Szegedi et al., 2020). To measure CSR disclosure activities, several approaches are used by researchers. The most conventional approaches are content analysis, reputational indices, questionnaire-based surveys, and a one-dimensional approach. Among these four approaches, the most common and widely used approach by many researchers is content analysis (Omair Alotaibi & Hussainey, 2016).

Prior literature provides evidence that CSR disclosure has an impact on leverage ratio. In different business environments and different contexts, the relationship between CSR disclosure and leverage shows varying results. Some studies showed a positive association between CSR disclosure and leverage (Hamrouni et al., 2019), while some studies showed a negative relationship (Xu & Yang, 2019). So, the contrasting results in different economic contexts make this literature more interesting to explore and study the relationship between CSR disclosure and leverage from a different perspective.

A study conducted by Yeh et al. (2020) on the relationship between CSR performance and the cost of debt in China shows a negative association. The result indicated that Chinese firms with higher CSR can rapidly reduce the cost of debt. The findings of this study are important for the Chinese market as well as those markets which heavily rely on debts. The study suggests that higher CSR disclosure can be used as a tool to control leverage levels.

Xu and Yang (2019) investigated the relationship between US firms' CSR rating and debt structure for the period 2001–2005. The result showed that higher CSR performance significantly decreases bank debt. Based on the assumption of the pecking-order theory that firms facing higher information asymmetry and agency problems, have difficulty in raising equity capital, and firms move to bank debt. The findings were consistent with the theory and showed that higher CSR facilitates equity capital and thus decreases debt financing.

Hamrouni et al. (2019) studied the relationship between CSR disclosure and the leverage ratio of non-financial French firms from 2010 to 2015. The result demonstrated that leverage ratios are positively related to CSR disclosure. The study is based only on the environmental, social, and governance (ESG) disclosure scores.

Meanwhile, Razali et al. (2017) conducted research to investigate the relationship between CSR disclosure by companies listed under the industrial product industry toward the cost of debt. A total of 59 samples of annual reports of listed companies were obtained and examined from 2012 to 2014. The regression analysis used and showed that CSR disclosure had a negative relationship with the cost of debt.

Harjoto (2017) examines the relationship between CSR and financial leverage and documented that higher CSR activities are negatively related to leverage. The study suggests that CSR disclosure acts as a substitute for a corporate debt tax shield when the financial leverage is lower.

Pijourlet (2016) studied the relationship between CSR and capital structure on a worldwide dataset of 5859 firm-year observations. The study found that CSR performance is negatively associated with firms' leverage. A firm with high CSR performance issues equity in larger amounts and thus the level of debt decreases.

A study conducted by De Klerk et al. (2015) showed that higher levels of CSR disclosure are associated with higher share prices. This study provides evidence that CSR disclosure by companies are useful to investor and shareholders, as it is related to share price information. Whereas leverage is controlled during the study, thus the result of the study indicates that CSR disclosure has a vital influence on the share price as well as capital structure.

Beiting et al. (2012) investigated the relationship between CSR performance and access to finances in the capital market. The findings of the study suggested that firms with better CSR performance are better positioned to obtain financing in the capital markets. The study recommended CSR activities provide an opportunity for businesses to finance their activities better and create optimal capital structure. Thus, better access to finance can be attributed to reduced agency costs due to enhanced stakeholder engagement and also reduced information asymmetry due to increased transparency.

Theoretical Framework and Hypothesis

While a number of theories have been used in CSR literature to explain the impact of high CSR disclosure on business operations, this study focused on information asymmetry's influence on capital structure (De Klerk et al., 2015). It can be argued that information asymmetry considerations between managers and shareholders affect the decisions of Omani companies' managers to provide higher levels of CSR disclosure. Based on agency theory, information asymmetry exists when there is a separation of ownership and control between shareholders and managers. CSR disclosure by the company managers is an opportunity for shareholders to know more about business activities and monitor management to make more accurate estimates of future earnings and cash flows(Healy & Palepu, 2001). Shareholders require more relevant information about the business profits and business future liabilities. Thus, CSR disclosure is used by managers to communicate information about the company's social performance to shareholders (Healy & Palepu, 2001). Additionally, higher CSR disclosure attracts institutional investors who have long-term investment perspectives (Dhaliwal et al., 2011).

When a business has more transparent disclosure, then it impacts more positively on leverage. Corporate social responsibility is a tool that is used by businesses to improve their image and position in society by performing different activities. Firms

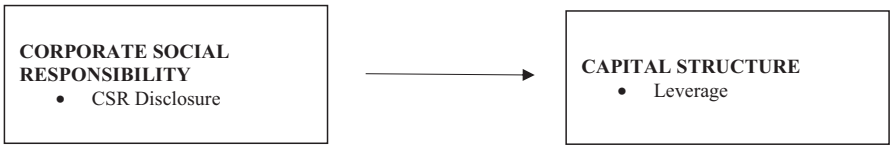

Fig. 1 Research framework – the relationship between CSR disclosure and leverage

with high CSR activities are in a better position to create a differentiated image in the competitive market and thus in a position to gain the advantage of keeping a balance in the leverage with lower cost (Razali et al., 2017). The CSR disclosure is associated with leverage; however, the results of some studies are positive (Razali et al., 2017; Hamrouni et al., 2019), while others suggested a negative relationship (Beiting et al., 2012; Pijourlet, 2016; Harjoto, 2017; Yeh et al., 2020).

Beiting et al. (2012) demonstrate that transparent CSR disclosure affects financing decisions by reducing capital constraints. In reality, high and quality CSR disclosure reduces information asymmetry between a firm and its investors and leads to lower equity costs (Dhaliwal et al., 2011; Bae et al., 2019) and lower leverage levels (Beiting et al., 2012; Harjoto, 2017; Xu & Yang, 2019). Thus, CSR disclosure can considerably reduce information asymmetry between firms and stakeholders. High CSR experiencing businesses show more profitability, growth, and lower risk of bankruptcy (Lins et al., 2017).

In light of previous literature, it can be argued that lenders are sensitive to CSR disclosures since the disclosures include relevant non-financial information that is not reported in financial statements, but it is considered to be useful for the assessment and evaluation of a firm's risk as well as value. However, the theoretical discussion is still unsettled. The theoretical framework is provided in Fig. 1. Many studies have been conducted in different business environments and contexts, which show different results. Thus, it is highly useful to conduct research in the context of Omani-listed companies, so the following hypothesis is proposed for the current study:

H: There is a significant negative relationship between CSR disclosure and leverage.

Research Methodology

Sample Size

This study aims to examine the relationship between CSR disclosure and firm leverage. This study used secondary data gathered from the annual reports of non-financial listed companies in the Muscat securities market (MSM) from 2016 to 2019. Using secondary data in research work is considered a valuable tool for developing knowledge, and explaining the research problem (Johnston, 2014). Thus, 291

firm-year observations have been considered for the current study as a sample unit for the period 2016 to 2019. This refers to panel data due to the inclusion of a number of years and a number of firms.

Measurements

The dependent variable is leverage; it is measured as total debt to total assets. Researchers usually suggest a debt ratio to measure the leverage of the business (Al-Shubiri, 2012). The debt to asset ratio is calculated as total debts divided by total assets, this ratio indicates the level of assets financed by debt. The study assumes CSR disclosure as an independent variable. The study used a content analysis approach to develop a CSR disclosure index. The content analysis method is also known as the disclosure approach to measuring CSR disclosure as a qualitative approach (Milne & Adler, 1999). Under the context analysis approach, the current study adopts the index method to measure the presence and absence of specific items by following a binary coding method (Kansal et al., 2014).

For measuring the CSR disclosure, it is essential to identify and indicate the appropriate unit of analysis that supported the objective of the study. Also, the selection of categories in which context units are classified under content analysis is imperative. The current study used the index which is proposed and developed by Ehsan et al. (2018), whereas slight changes have been made to fit Oman's laws and code of corporate governance. CSR disclosure index is developed on the basis of 40 elements which comprises five sub-themes. General community welfare, health and education, environment and energy, product and customer and stakeholders, and workforce are the five sub-themes of the CSR disclosure index. There are 11 items under general community welfare, five items under health and education, seven items under environmental and energy, nine items under product and customer, and finally, eight items under workforce. These five sub-themes, which comprise 40 items, also reflect the sustainability development goals which are identified by the United Nations and comprises 17 goals (UN, 2021). However, to fit with the country's requirements, minor modifications are made based on Oman's code of corporate governance (2016). The reliability of the CSR disclosure index is reported by Ehsan et al. (2018) as Cronbach's coefficient alpha value of 0.924, which is considered outstanding in accepting five sub-themes with 40 items.

There are two control variables that are assumed to be constant throughout the analysis. Firm size and firm age are used as control variables, which is also consistent with previous studies by Pijourlet (2016), Harjoto (2017), Razali et al. (2017). Xu and Yang (2019), Yeh et al. (2020). Firm size refers to the level of a firm's operations. It is calculated as a natural log of the total value of firm assets. Whereas firm age refers to the number of years the business is established (Ahmed & Hamdan, 2015). Thus, firm age is calculated as the number of years since the company was established. The summary of variables is given in Table 1.

Table 1 Summary of variables

Variables	Abbreviation	Description
Dependent variable – leverage		
Leverage	LEV	Total debt divided total assets
Independent variable – CSR		
Corporate social responsibility	CSR	Index based on 40th[h] elements
Control variable		
Firm size	FSZE	Natural log of total assets
Firm age	FAGE	No. of years since the firm was established

Research Design

It is assumed to have a negative relationship between CSR disclosure and leverage. To test the hypothesis the following regression model is proposed:

$$\text{LEV}_{i,t} = \alpha + \beta CSR_{i,t} + \text{Year } FE + \text{Industry } FE + \text{Firm } FE + \varepsilon_{i,t}$$

Here, LEV stands for leverage, which is measured as debt to asset ratio.

a	constant term
β	parameter for the independent variable
Subscript (i)	number of firms
Subscript (t)	time
CSR	Corporate social responsibility disclosure
Year FE	year fixed effect
Industry FE	industry fixed effect
Firm FE	firm fixed effect

The current study used STATA 15 for statistical analysis of variables and to check the objectives of the study. It is assumed a friendly statistical package that is highly recommended by the researchers for analysis of panel data (Baltagi, 2005). To solve the problem of outliers, the current study used winsorization of total assets. In order to control the problem of endogeneity, the study used regression analysis with a high-dimension fixed effect to control the unobserved or omitted firm characteristics which control the firm, year, and industry to provide more accurate results (Correia, 2016). In addition, the Hausman test is performed to select between regression analysis of fixed effect and random effect. The value of the Hausman test is less than 0.05, which recommends a fixed-effect model for the current study data analysis. To assess the normality of data, the skewness and kurtosis test is performed; however, the skewness values are ranged from −0.5 to 0.5 and the kurtosis values are ranged from −1 to 1, which indicated that data is normally distributed (Rani Das, 2016).

Results and Findings

Descriptive Statistics

The result of descriptive statistics is given in Table 2, which shows the values of the mean, median, standard deviation, minimum, and maximum variables used in this study. The mean value of leverage is reported as 47.58%, which is higher than the mean value of 25.81% as reported by Hamrouni et al. (2019) for French companies and also higher than the mean value of 29%, as reported by Pijourlet (2016) using a worldwide dataset of 5859 firms. The minimum value of leverage is 0.34 and the maximum value is 300.07, which indicates that there are variances in companies' leverage structures. The mean value of CSR is 42.15%, which shows that CSR disclosure of listed companies in Oman is still required to improve. Whereas the minimum CSR disclosure is 0.00%, which indicates that there are still some firms that do not have to develop CSR charters and implement CSR strategies even though the CSR disclosure is mandatory after the implementation of the new code. Additionally, the CSR disclosure maximum value is 93.00% which reflects a very high involvement and disclosure of CSR practices by companies The two control variables firm size and firm age have a mean value of 15.45 and 24.56, respectively. Which represents the overall size of firms and the age of companies operating at MSM.

Table 3 provides an interesting insight to understand the industrial structure and sectors of non-financial companies listed at MSM. There are 75 non-financial companies listed at MSM under 16 classified industrial sectors. The result reported in Table 3 shows the descriptive statistics of CSR disclosure, leverage, firm size, and firm age by industry. It is important to note that there are 16 non-financial industries operating at MSM. The energy and food industries are composed of 14 firms. However, the higher leverage ratio is reported in the Engineering industry as 144.03%, which is composed of only two firms. The higher CSR disclosure is reported in the food industry as 65.58%, which is composed of 14 firms. The control variable firm size by industry shows that the cement industry is the largest industry in size, which is calculated on the natural log of assets value. In addition, firm age by industry shows that the logistics industry is the oldest industry with a mean value of 41.50.

Table 2 Overall descriptive statistical results

Variables	*N*	Mean	Median	Std. Dev.	Min	Max
LEV	291	47.58	37.63	40.89	0.34	300.07
CSR	291	42.15	43.00	17.16	0.00	93.00
LN_FSZE	291	15.45	16.00	2.55	9.00	20.00
FAGE	291	24.56	22.00	10.06	3.00	45.00

LEV leverage, *CSR* corporate social responsibility, *LN_FSZE* Natural Logarithm of firm size, *FAGE* Firm age

Table 3 Descriptive statistical results by industry

Industry	Number of companies	LEV	CSR	LN_FSZE	FAGE
Cement	2	23.47	49.00	19.00	38.00
Chemicals	3	22.55	40.25	16.33	26.17
Commercial services	4	39.93	42.81	16.50	25.75
Construction material	7	68.09	35.07	16.37	24.00
Education	2	13.92	46.00	16.13	21.50
Electrical	2	19.56	53.00	18.00	32.00
Energy	14	63.88	54.06	18.48	14.02
Engineering	2	144.03	42.75	18.63	31.00
Food	14	50.40	65.58	15.50	33.50
Logistics	1	44.86	45.00	18.25	41.50
Mining	4	42.96	25.12	15.63	21.75
Oil and gas	5	44.56	50.45	17.95	24.10
Paper & glass	4	40.28	24.44	15.69	29.50
Telecommunication	2	47.61	61.13	21.00	16.00
Textiles	1	26.76	39.00	15.00	20.50
Tourism	8	20.93	36.10	16.30	25.03

LEV leverage, *CSR* corporate social responsibility, *LN_FSZE* Natural Logarithm of firm size, *FAGE* Firm age

Table 4 Correlation analysis

Variables	LEV	CSR	FSZE	FAGE
LEV	1.000			
CSR	−0.025	1.000		
FSZE	0.084	0.674***	1.000	1.000
FAGE	−0.208***	−0.132**	−0.141**	−0.141**

***$p < 0.01$; **$p < 0.05$; *$p < 0.10$

Correlation Analysis

The Pearson Correlation analysis is given in Table 4. A correlation with a value close to 1 indicated the correlation is strong while a value close to 0 refers to a weaker relationship. In addition, a negative relationship is shown by a negative sign, whereas a positive relationship is signaled by a positive sign.

Regression Result Based on Proposed Hypothesis

The regression result of the proposed hypothesis is shown in Table 5. The R2 of the model is 0.9447, which is considered to be a highly reliable value. The study tested the hypothesis to examine the relationship between CSR disclosure and leverage. The result of the hypothesis shows a significant negative relationship between CSR

Table 5 CSR disclosure and leverage

Hypothesis	Variables	Coefficients	Std. Err.	*t*-statistics	*p*-value
H	CSRI	−1.163***	0.185	−6.280	0.000
	LN_FSZE	3.258	2.584	1.260	0.209
	FAGE	3.403***	0.700	4.860	0.000
	Firm FE	Yes			
	Year FE	Yes			
	Industry FE	Yes			

R-squared = 0.9447, Adj. *R*-square = 0.9209

disclosure and leverage with a coefficient of −1.163 and a p-value of 0.000. This result fully supports the hypothesis that high CSR disclosure leads to reduced leverage ratio. This result is consistent with the study of Yeh et al. (2020), Hamrouni et al. (2019), and Pijourlet (2016), who have found a negative association between CSR disclosure and leverage in different times and contexts. The two control variables, firm size and firm age, show a positive association with leverage. The firm size shows a positive but insignificant association with leverage, whereas firm age shows a significant positive association with leverage.

This study tested the relationship between CSR disclosure and leverage. The hypothesis assumed that there is an inverse relationship between CSR disclosure and leverage. The proposed hypothesis is accepted in the context of Oman. This result confirms the negative association between CSR disclosure and leverage. According to the Oman code of corporate governance (2016), all the listed companies in Muscat Securities Market (MSM) are required to develop their CSR charter and disclose their CSR activities in annual reports. The findings of this study are consistent with the previous findings of Yeh et al. (2020), Hamrouni et al. (2019), and Pijourlet (2016). However, previous studies focused on the Environment, Social, and Governance (ESG) aspects of CSR only. Whereas the current study focused on five aspects of CSR practices which are further based on 40 elements. The current study attempts to cover all relevant aspects of CSR practices that are also relevant and fulfill the local requirements of the Omani market. The five subthemes are community welfare, education and health, environment and energy, product and customer, and finally, workforce. These five themes also satisfy the criteria of UN sustainability goals (UN, 2021). Thus, the current study is considered to fill the gap in a unique aspect.

The result of the current study indicates that an increase in CSR disclosure leads to reduce the level of listed companies in Oman. This finding is important, especially for those Omani firms and industries which have higher leverage. Table 3 reflects that higher leverage is found in the Engineering industry with a mean value of 144.03%, %, which is composed of two firms. Followed by the Construction industry and Energy industry with high leverage at 68.09% and 63.88%, respectively. Higher CSR disclosure is reported in the Food industry at 65.58%, followed by the Telecommunication industry at 61.13%. The leverage reported in the Food industry is 50.40% and in the Telecommunication industry is 47.61%. The results

suggest a significant negative association between CSR disclosure and leverage on Omani-listed firms.

This study confirms the agency theory notion, higher disclosure of information leads to reduced agency problems, and thus the information asymmetry between shareholders and managers decreases, which provides an opportunity for the firm to increase equity financing rather than debt financing. Thus, the negative association between CSR disclosure and leverage is supported by the data of Omani-listed firms. This finding provides valuable insight to managers and also to regulatory bodies on the way to control and reduce leverage. This study confirms the implication of the suggested hypothesis in the context of Oman.

CSR disclosure is used as a tool to control leverage, and specifically during global economic stress. A study by Huang and Ye (2021) reported the importance of CSR disclosure during COVID-19 for publicly listed companies. Firms with high leverage face high risk during the pandemic and specifically, the worst impact is adversely affecting companies with low CSR disclosure. Whereas firms with low leverage are self-protected regardless of their CSR disclosure. Thus, the study conducted by Huang and Ye (2021), provides an important understanding to managers, banks, regulators, and all stakeholders that CSR disclosure influences leverage and protects firms from bankruptcy.

The study has a few limitations; first, it covers the annual reports of only non-financial public listed companies. The annual reports of financial publicly listed companies are not included in the sample because of their different nature of business due to which financial companies have higher leverage. The study covers a limited period from 2016 to 2019 because the updated code of corporate governance was implemented in 2015 and only from 2016 did the annual reports reflect the requirements of the new code. Future research could focus on the period 2020 and so on to get confirmation of these findings. Future research could be conducted in other country aspects or consider cross-country comparisons specifically GCC counties.

Conclusion

The current study evaluates the relationship between CSR disclosure and the leverage of Omani non-financial listed companies. It is argued that CSR disclosure provided by company management reduces information asymmetry between managers and shareholders. Thus, higher levels of CSR disclosure are expected to be associated with lower leverage levels. The study evaluates the negative association between CSR disclosure and leverage levels. The study constructed a CSR disclosure index by considering different aspects of CSR practices. Thus, the assumed hypothesis is supported by the results of this study. In addition, CSR disclosure helps in reducing agency problems as well as information asymmetry between shareholders and managers. These findings are interesting for policymakers,

management, board of directors, and shareholders in evaluating companies' CSR performance to control leverage.

This study contributes to the literature by overcoming some important prior gaps and conducting this study on the content of Omani-listed companies. The CSR disclosure measure is based on content analysis, where the index is developed on the broader range of CSR activities. In addition, the time frame used in this study is also important because this study was conducted after the implementation of the current code of corporate governance in Oman, where CSR disclosure is considered mandatory for all listed firms. The research findings will be of interest to the board of directors, regulators, and shareholders from other GCC countries where the leverage of the companies is high.

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Audit Committee Financial Expertise, Tenure, and Capital Structure Decisions, Evidence from Turkey

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Abstract Capital structure theory proposes that a company's capital structure is affected by a variety of factors. The most important of these factors is corporate governance practices. The audit committee is recognized as an important corporate governance mechanism that stands out with its monitoring and oversight responsibility. The audit committee helps to make financial decisions more soundly by providing coordination between a company's independent audit, internal audit, and the board of directors. In addition, firms ensure, through the audit committee, that managers' decisions to improve firm performance are ethically monitored. Previous studies have so far given little weight to the relationship between the audit committee and capital structures. Therefore, this study examines the impact of audit committee characteristics on the capital structure, with a particular focus on the financial expertise and tenure of audit committee members. The sample of the study includes mostly hand-collected 1,638 firm-year observations obtained from Turkey's listed non-financial companies between 2009 and 2019. Empirical results indicate that the financial expertise and long tenure of the audit committee members are associated with lower financial leverage. Moreover, the presence of less tenure and nonfinancial experts members in the audit committee is associated with higher financial leverage. This study fills a literature gap where empirical evidence on how the audit committee affects capital structure is insufficient.

Keywords Capital Structure, Leverage, Audit Committee, Financial Expertise, Tenure

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Introduction

This study investigates the effect of audit committee characteristics on the capital structure, with a particular focus on the financial expertise and tenure of audit committee members. Very few studies investigate the possible relationship between the audit committee and leverage. The most important reason is that the main responsibility for capital structure decisions rests with the board of directors (Alves et al., 2015; Meah, 2019). Capital structure, in other words, leverage is defined as the ability to use debt to finance operations and expand businesses (Gong & Phelan, 2020). Capital structure decisions are important because they can affect a company's profitability, risk profile, and valuation. The right mix of debt and equity can help a company maximize its value and minimize its risks (Morellec et al., 2012). The audit committee oversees the financial reporting process and ensures the accuracy of the information presented in the financial statements (Cohen et al., 2014). One of the key ways in which the audit committee fulfills this role is by monitoring the company's leverage. A high level of leverage can be risky for a company, as it can lead to financial difficulties if the company cannot make its debt payments. For this reason, the audit committee closely monitors the company's leverage to help the board keep its leverage manageable.

The audit committee is vital to any company's governance structure, and its role in capital decisions cannot be underestimated. The audit committee provides critical oversight of management's financial reporting and disclosure practices, and its members are typically experienced financial, accounting, and tenured professionals (DeFond et al., 2005). As such, the audit committee is uniquely positioned to provide insights and recommendations on capital decisions. The audit committee's role in capital decisions extends beyond mere financial oversight. The committee is also responsible for ensuring that management has adequate systems and controls to manage the company's financial risks (The Blue Ribbon Committee, 1999). This includes assessing the company's exposure to financial risks, evaluating the effectiveness of financial risk management practices, and making recommendations to the board of directors on how to best mitigate financial risks (Abdullah & Shukor, 2017).

The most important reason why few studies have been done on the relationship between audit committees and capital structure is that the audit committee is a relatively new corporate governance mechanism and came to the fore only at the beginning of the twenty-first century (Lin et al., 2008). Recent studies reveal that the audit committee can be an important determinant in capital structure decisions. Meah (2019) found empirical findings that larger and more independent audit committees have lower leverage. Al Lawati and Hussainey (2021) found that the financial expertise of audit committee members positively affects the leverage ratio. Tarus and Ayabei (2016) investigated the relationship between board composition and the capital structure, and the presence of the audit committee was used as one of the independent variables. The study's findings show no significant relationship between the presence of the audit committee and the capital structure.

The main findings of our study reveal that audit committee financial expertise and tenure is an important factor in capital structure decisions. In addition, our main findings are supported by additional analyses with lagged variables and the interaction variable derived from independent variables. Our study makes important contributions to the limited literature, administrators, and practitioners. Although the audit committee's duties and responsibilities regarding financial reporting quality are predominant, the lack of appropriate leverage for the firm can make it difficult to fulfill these duties and responsibilities. Companies can improve their financial performance and governance by understanding the audit committee's role in the capital structure.

Literature

A company's capital structure refers to the mix of debt and equity that the company uses to finance its operations (Shubita & Alsawalhah, 2012). The capital structure is an important factor in a company's financial stability and its ability to generate profits (Herciu & Ogrean, 2017). Capital structure decisions are a key part of financial decision-making for any company. These decisions can have a major impact on a company's financial stability and performance. As such, it is important to evaluate capital structure decisions in terms of finance theories. There are a number of different finance theories that can be used to evaluate capital structure decisions. One popular theory is the trade-off theory (Baxter, 1967). This theory suggests that there is a trade-off between the benefits of debt and the costs of debt (Titman & Wessels, 1988). Companies must weigh the benefits and costs of debt in order to make an optimal capital structure decision. Another popular theory is the pecking order theory (Frank & Goyal, 2003). This theory suggests that companies will prefer to use internal financing before using external financing. This is because internal financing is typically less expensive than external financing. Companies will only turn to external financing when they cannot finance their projects with internal sources. There are a number of other finance theories that can be used to evaluate capital structure decisions. These theories can provide insights into the optimal capital structure for a company. By understanding the different trade-offs and preferences involved in capital structure decisions, companies can make better-informed decisions that improve their financial stability and performance.

Previous studies investigating the determinants of capital structure generally can fall into two categories: firm characteristics and corporate governance. Whether corporate governance is decisive in capital structure decisions has been the subject of many studies. This research has generally found that corporate governance plays a significant role in these decisions and that a number of factors can influence how corporate governance affects capital structure decisions. One of the most important factors that have been identified is the level of control that shareholders have over the firm (Brailsford et al., 2002). This is because shareholders are the firm's ultimate owners, so they have an ultimate say in how the firm is run.

If shareholders have a high level of control, they are more likely to influence capital structure decisions. Another important factor is the level of transparency, and disclosure is also an important factor (Aggarwal & Kyaw, 2009; Li et al., 2020). This is because if shareholders and the board of directors are not fully informed about the firm's financial condition, then they may make sub-optimal decisions. Finally, the composition of the board of directors (Gilani et al., 2021; Tarus & Ayabei, 2016). This is because the board of directors is responsible for making decisions on behalf of the shareholders. If the board is composed of individuals with much experience in finance and accounting, then they are more likely to make sound capital structure decisions.

There is a large body of research that has examined the role that firm characteristic plays in capital structure decisions. Some of the most important characteristics include the firm size (González & González, 2012; Kurshev & Strebulaev, 2015), the firm age (Kieschnick & Moussawi, 2018), the growth rate (Baral, 2006; Ooi, 1999), the profitability (Herciu & Ogrean, 2017), and the industry (Dakua, 2019; Miao, 2005). Each firm's characteristics can significantly impact the optimal capital structure for a given firm. For example, Scherr and Hulburt (2001) argue that larger firms tend to have more debt than smaller firms. This is because larger firms have more assets that can be used as collateral for loans and tend to have better access to capital markets. Firm age is also an important factor, with younger firms tending to have more debt than older firms (Michaelas et al., 1999). This is likely because younger firms have less financial history and are therefore riskier by lenders. The industry in which a firm operates can also impact its capital structure. For example, Qian (2003) claims that firms in capital-intensive industries tend to have more debt than firms in less capital-intensive industries. This is because they need to raise more capital to finance their operations. Finally, firms with high growth potential tend to have more debt than firms with low growth potential (Billett et al., 2007). This is because lenders are willing to provide more capital to firms with high growth potential to finance their expansion.

The audit committee is a key governance body that oversees the financial reporting process and provides oversight of the organization's financial risks. Given the importance of these responsibilities, the audit committee should be composed of financial experts and tenured members who can provide sound guidance on capital structure decisions. These experts should be familiar with the company's financial statement and should be able to provide advice on how to optimize the company's capital structure. The audit committee should also have tenured members who can provide insights on the company's long-term financial goals and how to achieve them best.

Capital structure decisions are a key part of a company's financial strategy, and audit committees play a vital role in overseeing these decisions. Audit committees with solid financial expertise are better able to understand the risks and implications of different capital structure choices and are better equipped to make informed and effective decisions. Audit committee financial expertise is particularly important in today's business environment, where companies face increasing pressure to make

sound financial decisions. In addition, the global economic crisis has spotlighted the need for strong financial oversight, and audit committees are uniquely positioned to provide this oversight. With their deep understanding of financial issues and their knowledge of best practices, audit committees can help companies make sound capital structure decisions that protect and enhance shareholder value.

H1: There is a relationship between audit committee financial expertise and capital structure decisions.

The audit committee tenure is highly likely to influence capital structure decisions. This is because audit committee members who have been in their positions for a longer time are more likely to understand the company's financial situation better and be more comfortable making decisions regarding its capital structure. Additionally, audit committee members who have been in their positions for a longer period are more likely to have established relationships with the company's management team and communicate their recommendations effectively.

H2: There is a relationship between audit committee tenure and capital structure decisions.

Methodology

Sample

The study sample includes mostly hand-collected 1638 firm-year observations obtained from Turkey's listed non-financial companies between 2009 and 2019. We chose our example companies according to the following two criteria. First, we excluded all financial companies from the study sample due to different financial statement structures. Second, we excluded companies that did not form audit committees and for which audit committee data is missing. After eliminating companies from the financial industry and those with the missing audit committee and financial information, the final sample comprises 1631 firm-year observations, representing 35% of all companies listed on the market.

Research Model and Variables

Multiple regression analysis was used to test hypotheses regarding the impact of audit committees on capital structure decisions. We employed audit committee characteristics as independent variables: financial expertise and tenure. We employed leverage for measuring capital structure decisions as a dependent variable. To reduce the outlier effect, all continuous variables were winsorized in the 1–99% percentile.

The following estimated model is created to investigate the effect of financial expertise and tenure on capital structure:

$$\begin{aligned} \text{Leverage}_{it} &= \alpha + \beta_1 \text{Financial}_{it} + \beta_2 \text{Tenure}_{it} \\ &+ \text{Control variables}_{it} + \text{Industrials} + \text{Years} + \varepsilon_{it} \end{aligned} \quad (1)$$

Where

Leverage: Ratio of total debt to total assets
Financial: Take value one if at least one member of the audit committee has expertise in accounting and/or finance; otherwise zero
Tenure: Take a value if at least one member of the audit committee has 3 years or more of experience; otherwise zero
AC_Size: Total number of audit committee members
AC_Ind: The proportion of independent members on the audit committee
B_Size: Total number of board members
B_Ind: The proportion of independent member of the board
B_Gender: Take a value if at least one member of the board is female; otherwise zero
B_Race: Take a value if at least one member of the board is foreign; otherwise zero
Duality: Take value one if the board chairman and the CEO are not the same person; otherwise zero
BIG4: Take value one if the firm's financial reports audited by a Big 4 audit firm; otherwise zero
Auop: Take value one if the audit firm has given an unqualified opinion on the company's financial reports; otherwise zero
Firm_Size: Log of the book value of total assets
M/B: Ratio of market value of equity and book value of equity
ROA: Proportion of net profit to total assets
ROE: Proportion of net profit to shareholders' equity
Firm_Age: Natural logarithm of company age
Sales: Log of the gross sales
Current: Ratio of current assets to short-term liabilities

Data Analysis and Results

Descriptive Analysis

In Table 1, shown below, the mean, standard deviation, median, maximum, and minimum values of the model's dependent, independent, and control variables are given. For example, the average leverage ratio of non-financial companies listed on Borsa Istanbul is 0.501, with a median value of 0.243. In addition, 56% of these companies have at least one financial member from the audit committee, and 34% have a member with at least 3 years of tenure.

Table 1 Descriptive statistics

Variable name	Mean	Standard dv.	Median	Min.	Max.
Leverage	0.501	0.243	0.529	0.041	1.102
Financial	0.563	0.496	1	0	1
Tenure	0.345	0.475	0	0	1
AC_Size	2.065	0.314	2	1	6
AC_Ind	0.810	0.379	1	0	1
B_Size	7.193	2.155	7	3	15
B_Ind	0.243	0.142	0.285	0	0.667
B_Gender	0.593	0.491	1	0	1
B_Race	0.321	0.467	0	0	1
Duality	0.801	0.399	1	0	1
BIG4	0.623	0.484	1	0	1
Auop	0.948	0.220	1	0	1
Firm_Size	19.887	1.770	19.552	14.870	25.712
M/B	1.924	1.075	1.642	0.151	14.170
ROA	0.037	0.092	0.032	−0.268	0.306
ROE	0.006	0.409	0.073	−2.506	0.566
Firm_Age	3.645	0.479	3.688	0.693	4.787
Sales	19.544	2.434	19.357	0	25.230
Current	2.343	4.725	1.42	0.23	13.57

Correlation Matrix

Table 2, shown below, shows results of the Pearson's correlation matrix for the entire sample. None of the variables are in a correlation relationship above 0.80, indicating that multicollinearity is not a serious problem for the study. The table shows that audit committee financial expertise is negatively and significantly correlated with leverage, while audit committee tenure is positively correlated with leverage but insignificant. In addition, the table reveals that the majority of control variables are significantly related to leverage.

Regression Results

Table 3 shows the regression analysis results using the independent and control variables expected to affect the capital structure. Model 1 shows the main regression model in which hypotheses are tested and the results are reported in column one. Model 2 shows the model in which hypotheses are tested with lagged variables and the results in the second column. The table shows that audit committee financial expertise and tenure are negatively and significantly associated with leverage. In addition, the results in model 2 support this conclusion. Based on these findings, H1 and H2 hypotheses are supported. In other words, companies with more

Table 2 Pearson and Spearman correlation analysis

Variable name		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
Leverage	(1)	1																		
Financial	(2)	−0.03***	1																	
Tenure	(3)	0.01	−0.08*	1																
AC_Size	(4)	0.02	0,05**	−0.01	1															
AC_Ind	(5)	0.12*	0.11*	−0.18*	0.03	1														
B_Size	(6)	0.02	0,11*	−0.00	0.13*	0.20*	1													
B_Ind	(7)	0.12*	0.12*	−0.17*	−0.03	0.66*	−0.09*	1												
B_ Gender	(8)	−0.00	0,10*	0.01	−0.03	0.05**	0.09*	−0.01	1											
B_Race	(9)	0.08*	−0.01	0.04***	0.09*	0.00	0.21*	−0.07*	−0.11*	1										
Duality	(10)	0.08*	0.08*	−0.13*	−0.00	0.06*	0.21*	0.01	0.03	0.10*	1									
BIG4	(11)	0.11*	0.08*	−0.07*	0.06*	0.08*	0.28*	−0.01	0.04**	0.28*	0.27*	1								
Auop	(12)	−0.09*	−0.00	−0.02	−0.00	0.02	0.14*	−0.01	0.11*	0.01	0.19*	0.14*	1							
Firm_ Size	(13)	0.22*	0.08*	−0.03	0.15*	0.21*	0.52*	0.10*	0.06*	0.16*	0.22*	0.42*	0.19*	1						
M/B	(14)	−0.31*	0.04**	−0.02	−0.00	−0.04**	−0.04***	−0.05**	−0.10*	0.12*	−0.05*	0.07*	0.01	−0.17*	1					
ROA	(15)	−0.42*	0.04***	0.00	0.02	0.04***	0.14*	−0.02	−0.00	0.07*	0.09*	0.0.10*	0.15*	0.18*	0.29*	1				
ROE	(16)	−0.39	0.00	0.02	0.03	0.01	0.11*	−0.02	0.01	0.06*	0.05*	0.04**	0.016*	0.15*	0.15*	0.71*	1			
Firm_ Age	(17)	0.05**	0.02	0.01	−0.05**	0.10*	0.08*	−0.07*	0.02	0.05*	0.10*	0.22*	0.02	0.20*	0.07*	0.06*	0.00	1		
Sales	(18)	0.27*	0.02	−0.02	0.11*	0.15*	0.44*	0.04***	0.06*	0.23	0.23*	0.35*	0.18*	0.79*	−0.10*	0.19*	0.16*	0.18*	1	
Current	(19)	−0.36*	−0.02	−0.03	−0.01	−0.10*	−0.02	−0.09*	−0.02	−0.04	−0.08*	−0.10*	−0.00	−0.21*	0.29*	0.11*	0.07*	−0.12	−0.21*	1

*, **, *** = Significant at the 1%, 5%, and 10% confidence levels, respectively

Table 3 Regression analysis

	Model 1			Model 2		
Variables	Coefficient	*t*-statistic	*p* value	Coefficient	*t*-statistic	*p* value
Financial	−0.199**	−2.15	0.032	−0.030*	−3.26	0.001
Tenure	−0.004***	−1.79	0.073	−0.005**	−2.08	0.037
AC_Size	−0.009	−0.68	0.494	−0.007	−0.53	0.598
AC_Ind	0.012	0.70	0.486	0.012	0.69	0.491
B_Size	−0.009*	−3.24	0,001	−0.009	−2.86	0.004
B_Ind	−0.048	−0.68	0.500	−0.051	−0.66	0.507
B_Gender	−0.016***	−1.73	0.085	−0.020	−2.05	0.041
B_Race	0.007	0.75	0.452	0.003	0.35	0.728
Duality	0.020***	1.79	0.074	0.023	1.92	0.055
BIG4	0.039*	3.46	0.001	0.050	4.25	0.000
Auop	−0.058**	−2.25	0.025	−0.045	−1.85	0.064
Firm_Size	−0.013	−1.60	0.111	−0.021	−2.14	0.033
M/B	−0.030*	−3.62	0.000	−0.033	−4.28	0.000
ROA	−0.696*	−7.06	0.000	−0.757	−7.67	0.000
ROE	−0.098*	−5.50	0.000	−0.088	−5.46	0.000
Firm_Age	0.027**	2.45	0.014	0.023	1.95	0.052
Sales	0.038*	5.20	0.000	0.043	4.81	0.000
Current	−0.009**	−2.35	0.019	−0.010	−2.16	0.031
Intercept	0.095	1.01	0.311	0.188	2.10	0.036
Industry effects	YES			YES		
Year effects	YES			YES		
Observations	1.638			1.484		
F statistic	42.28			44.81		
Adjusted R^2	0.4646			0.4866		

*, **, *** = Significant at the 1%, 5%, and 10% confidence levels, respectively. To minimize data loss and extreme values in the regression analysis, continuous values were winsorized at the 1st and 99th percentile

experienced and financially savvy audit committees are less likely to be highly leveraged. This relationship is likely because audit committees are important in overseeing a company's financial reporting and compliance with debt covenants. Therefore, companies with strong audit committees are less likely to take on excessive debt and become overextended.

Table 4 shows the regression analysis results using interaction and control variables expected to affect capital structure. The results for model three are reported in column three and for model four are reported in column four. The results indicate that both non-financial experts and untenured audit committee members are positively and significantly associated with leverage. This result is consistent with the main findings in model 1. In addition, this finding shows that companies with these types of committee members are more likely to have higher levels of debt. This is likely because these individuals are less likely to be aware of the potential risks associated with taking on debt. As a result, companies with these committee members may be more likely to make imprudent decisions regarding leverage.

Table 4 Regression analysis

	Model 3			Model 4		
Variables	Coefficient	*t*-statistic	*p* value	Coefficient	*t*-statistic	*p* value
Non (financial × tenure)	0.025**	2.50	0.013			
Financial × tenure				−0.015	−1.25	0.210
AC_Size	−0.010	−0.76	0.447	−0.008	−0.63	0.527
AC_Ind	0.013	0.78	0.433	0.012	0.77	0.442
B_Size	−0.009*	−3.31	0,001	−0.009	−3.25	0.001
B_Ind	−0.053	−0.74	0.460	−0.049	−0.69	0.489
B_Gender	−0.019***	−2.03	0.043	−0.017	−1.84	0.067
B_Race	0.006	0.67	0.506	0.006	0.62	0.537
Duality	0.021***	1.80	0.072	0.022	1.94	0.053
BIG4	0.041*	3.63	0.000	0.041	3.65	0.000
Auop	−0.057**	−2.22	0.027	−0.057	−2.26	0.024
Firm_Size	−0.015	−1.80	0.072	−0.014	−1.70	0.090
M/B	−0.031*	−3.92	0.000	−0.031	−3.93	0.000
ROA	−0.699*	−7.07	0.000	−0.694	−7.06	0.000
ROE	−0.097*	−5.48	0.000	−0.097	−5.54	0.000
Firm_Age	0.027**	2.48	0.013	0.029	2.56	0.011
Sales	0.039*	5.34	0.000	0.039	5.22	0.000
Current	−0.008**	−2.34	0.019	−0.009	−2.37	0.018
Intercept	0.091	0.99	0.324	0.068	0.73	0.464
Industry effects	YES			YES		
Year effects	YES			YES		
Observations	1.638			1.638		
F statistic	44.15			43.25		
Adjusted R^2	0.4679			0.4665		

*, **, *** = Significant at the 1%, 5%, and 10% confidence levels, respectively. To minimize data loss and extreme values in the regression analysis, continuous values were winsorized at the 1st and 99th percentile

Conclusion

A company's capital structure refers to the mix of debt and equity that the company uses to finance its operations. The capital structure is an important factor in a company's financial stability and its ability to generate profits. On the other hand, the audit committee is an important corporate governance mechanism responsible for ensuring that the company has the necessary financial resources to support its operations and growth. With this study, we aim to contribute to the understanding of how these two important corporate governance mechanisms interact and to give an idea about the potential benefits and costs of different capital structures for companies.

This study explores the relationship between audit committee financial expertise and tenure and capital structure decisions. In this context, a regression analysis was carried out using 1638 observations collected from non-financial companies traded

in Borsa Istanbul between 2009–2019. The results show that audit committee financial expertise and tenure influence capital structure decisions.

Our findings make several significant contributions. First, we have contributed to limited literature by investigating whether audit committee financial expertise and tenure are associated with capital structure decisions. Second, our study is important for understanding the relationship between the audit committee and capital structure decisions of companies in developing countries. In developing countries, the capital structure decision is even more important because the cost of capital is often higher than in developed countries. Thus, the capital structure decision is important for companies in developing countries because it can affect the company's cost of capital, profitability, and ability to raise capital in the future. In developing countries, where there is often a lack of transparency and weak corporate governance, the audit committee can play a vital role in ensuring that the capital structure decisions are in the company's and its shareholders' best interests. Finally, the implications of the study have the potential to provide valuable insights for policymakers. Because audit committees with more financial expertise tend to have lower levels of leverage, policymakers may require companies to have more financial expert members on their audit committees.

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A Comparative Analytical Study for Renewable Energy Sources and Its Future in the Arab World

Jehad Al Khalaf-Bani-Younes, Salah Mahdi Darwash, and Kawther Abbas Sallal

Abstract There is a terrible imbalance in the distribution of energy to those in need. To address this problem, we propose an analytical study that shows a summary of the international experiences in the use of renewable energy sources. This study holds a deep and comprehensive comparison between the renewable energy sources in terms of efficiency, land space, manpower, cost value, and capacity and its effect on the environment. The important features of solar energy in the Arab World, which was divided into three domains: northern, central, and southern, where solar energy was qualitatively evaluated and compared with its global counterparts.

This study presents the best and safest solution by using renewable energy sources, which will contribute to solving the escalating water problem, reducing pollution, and preserving the environment.

The results of this research show that the central domain of the Arab World is one of the areas of receiving great solar energy. The countries of the Arab Gulf have the highest amount of radiation in the world. Solar radiation in the Sultanate of Oman is 3–4 times that of Europe, which would raise the efficiency of the solar power station by more than 25% and reduce costs.

Keywords Renewable energy · Solar energy · Wind energy · Power stations · Environment

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Introduction

The pursuit of energy is increasing to meet the demand for industrial purposes, and due to the increasing population of the world; energy is threatened by reaching a stage of imbalance between the need for it and population growth (Bani-Younis, 1998; Fridkin, 1988; Hamakawa, 2003). And traditional fuels have advantages that qualify for competition and continuity, in addition to renewable sources that man has been using for his benefit (Hamakawa, 2003). To meet the needs of those destitute of energy, scientists and engineers turned to renewable energy sources, hoping to find alternatives to traditional sources that are on the way to depletion or are almost depleted. Renewable energy is generally considered under research and experiments (Report about the need of the electrical grid, in the sultanate of Oman, for extra power generation to meet the growing demand in next years, 2003).

The Arab world is one of the regions rich in renewable energy sources. The most important forms of this energy are solar energy, wind energy, nuclear energy, and energy from the seas and oceans (Al-Alawi, 1999a; Heinemann, 1998). These renewable energy sources vary in their importance and the extent to which they attract the attention of researchers and engineers.

Wind energy is a source of renewable energy, especially in countries with strong and persistent winds, such as Azerbaijan, as well as in mountainous heights or on beaches and over water bodies.

Wind energy is one of the cleanest, safest, and most secure sources of electricity production, but so far it is still narrowly spread due to its poor economic feasibility, the urgent need to store the generated energy, and the fluctuation of the produced power from time to time.

Studies and research have shown (Hamakawa, 2014; Holttinen et al., 2007). Table 1 below is showing related information to generate one kilowatt (1 kW) only from a wind power station using wind energy.

Solar Energy

Solar energy plays a crucial role in meeting the energy demand, and it is one of the most used renewable resources in the world (Assad & Rosen, 2021). There are many characteristics that solar energy has, including that it is an exhaustible resource, clean, without noise, technology development, and low maintenance costs compared to other renewable resources (Assad et al., 2020).

Table 1 materials used to generate **1 kW**

Materials used	(in the sea) 800 kg of concrete +260 kg of minerals (In the land) 100 kg of concrete +200 kg of minerals
Used land	10 MW/km^2
Power supply factor	0.2

Moreover, the earth has sustainable resources such as the sun to supply electricity. When photovoltaic (PV) modules are placed toward the sun, sunlight radiations are directly converted into energy (Abdelsalam et al., 2021; Assad et al., 2020; Assad & Rosen, 2021). This conversion results in green energy, therefore it has gained wide popularity due to its eco-friendly operation (Ahmadi et al., 2021).

The most suitable and economical areas for the exploitation of solar energy are (Bozguenda et al., 2005; Marvart, 2000; Voldek, 1988): sunny places with high thermal radiation, high mountain areas, and remote areas.

The Arab World Is the Epicenter for Collecting Solar Energy

In order to study the feasibility and effectiveness of exploiting solar energy in the Arab world, the researchers in this study conducted a comprehensive geographical and climatic survey of the regions of the Arab world using various research tools such as the world atlas, wind distribution map, heat distribution tables, drought and humidity factors, and others.

Because of the climatic variation across the Arab world and its geographical dimensions, which extend to nearly 4000 km from north to south, the Arab world has been divided into three domains: Northern, Central, and Southern. By comparing what was previously mentioned with Europe, we prepared a qualitative assessment of the radiation intensity and thus the level of solar energy throughout the months of the year in the different regions of the Arab world and compared it with its counterparts in Europe, as shown in Fig. 1, where we concluded from this survey the following results:

The electricity generated depends on the extent of the hours of clearing and the intensity of the sun's brightness. In Europe, that period reaches (4–5) h out of 10 h, which is the annual average length of the day, while in the Arab countries it is (9–10) h out of 12 h. Figure 1 shows a comparison between the intensity of the sun's brightness and the hours of clearing in different parts of the world, including the regions of the Arab world.

The total number of sunny hours in the Arab world equals 3000 hours annually, which is a very high rate that exceeds other parts of the world, which makes the possibility of using solar stations in the Arab world encouraging, saving, and with a wonderful future. It also opens wide horizons for researchers in the field of energy to give this strategic field its due share of study, and it is imperative to invest the necessary and sufficient funds to develop research related to this vital field.

Figure 1 shows that there is a clear difference between the three domains of the Arab world; north, center, and south, where the middle of the Arab world – which includes most of the Arab countries, including the countries of the Arabian Peninsula and North Africa – outperforms its northern and southern counterparts by 30% of the annual solar hours.

It is clear that the south of the Arab world is distinguished, unlike its northern and central domains, with more hours of brightness in winter, and it turns out that the

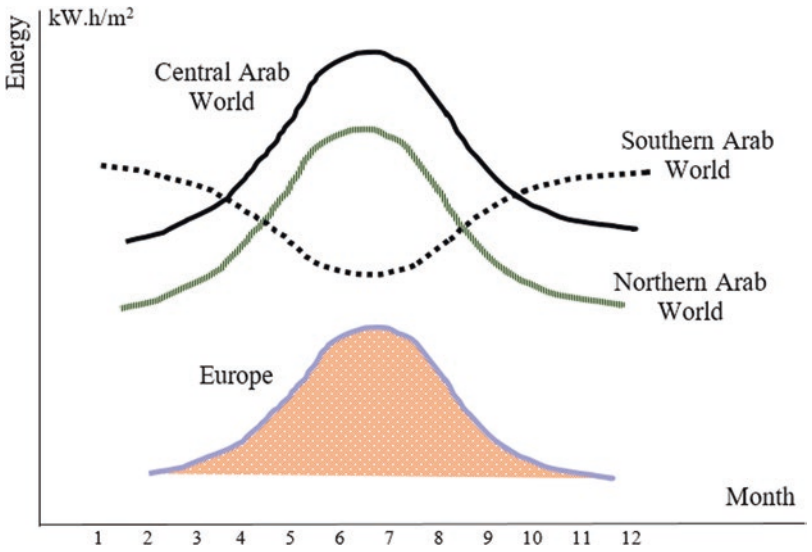

Fig. 1 Heat rates of solar around the Arab world and Europe

annual radiation rate is almost constant if the Arab world is taken as a single sentence, and this is what makes the integration in the electrical field between Arab countries a very important issue of interest and urgency, especially when the electrical connection in a unified network will lead to the following results:

- Significant decrease in the prices of generated electric power
- Increasing the stability of the electrical system, raising its efficiency and reliability, and minimizing the periods of power outages
- Reducing pollution and preserving the environment
- Its economy is compared to the usage of traditional fuel sources
- Using surplus energy in desalination, in order to conserve already limited water resources

To achieve the above, we urgently need efforts and successive steps in the field of research and studies on renewable energy sources, especially solar energy with a promising future.

Comparison Between Solar Power Stations and Other Energy Sources

In order to get a clear and detailed picture of the characteristics of renewable energy sources, a comprehensive comparison was made between solar power stations and other energy sources.

The Area of Used Land

It means the area of land needed to generate one megawatt of electrical power.

This is considered one of the most important elements in evaluating the feasibility that related to the type of station, because land prices constitute a large percentage of the fixed costs of establishing an electrical station. Because of rising prices of lands, the impact of this indicator is constantly escalating.

In the Sultanate of Oman, land prices have increased significantly in recent decades, which confirms that the used land index will have the final say in the future. Figure 2 presents a comparison between the land area needed to generate one megawatt of electricity using different types of electrical stations (Bani-Younis, 1998; Fridkin, 1988; Hamakawa, 2003). It is clear from the Fig. 2 that fuels are still ahead of solar stations in terms of the area of land needed to generate a unit of electricity, and this is one of the most important negative points in solar stations, which, along with some other indicators, stands as a stumbling block to the widespread exploitation of solar energy.

In the Arab countries, there are large areas of land and deserts, where the desert area in the Arab world exceeds 70% of the total area, making the impact of this indicator much less than its impact in the narrow and limited European countries, which with all that, it has made better efforts to exploit the solar energy.

On the other hand, a closer look at Fig. 2 shows a decrease in the areas needed for solar stations in the future, due to the expected future progress in engineering, the materials used in the manufacture of solar cells, which will make them more advanced and require less space, and this encourages the continuation of tireless efforts in this field. Land prices will rise in the future, but the space needed for solar stations will be reduced.

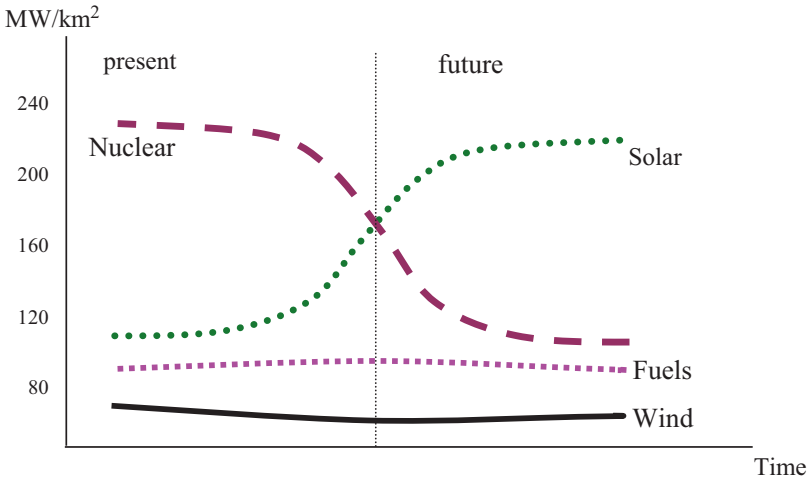

Fig. 2 Comparison between areas of different stations

It also appears that wind energy is at the bottom of Fig. 2 in terms of the area needed. Despite this, wind energy will remain limited in the Arab world due to the low rate of wind speed, especially in a country such as the Sultanate of Oman. As for nuclear stations, they are – as shown in Fig. 2 – non-competitive in terms of land areas, not to mention their destructive environmental effects, in addition to the many restrictions and other problems that surround them.

Employed Labor

It means the number of people required to be available in the electrical station as employees and workers in order to generate one megawatt of electrical power. The comparison between the different electrical stations is shown in Table 2 (Bani-Younis, 1998; Fridkin, 1988; Hamakawa, 2003; Report about the need of the electrical grid, in the sultanate of Oman, for extra power generation to meet the growing demand in next years, 2003).

From Table 2, we can find an important advantage of solar energy: it can emerge in reducing the number of employed labor needed and providing manpower by 25%, as it outperforms other types of traditional and non-traditional energy sources in this regard. And if we take into account that most of the labor in the Arab world is either cheap or low-paid, we can conclude that this indicator pays for the establishment of solar stations, but at a ratio that is between weak and medium.

Physical Capacity (Manufactured Material Consumption)

It means the number of different materials needed to build a station, and this comparison is highlighted in the following table (Hamakawa, 2003).

It is also clear from the previous comparison that the sources of renewable energy vary clearly among themselves in terms of the materials used. It's clear that solar stations are superior to other types of power stations that use ocean heat or even wind, especially in terms of the use of minerals, where their need in solar stations is reduced to a minimum. But it should be emphasized that solar stations are unique in the need for reflective materials, and this in turn requires additional economic costs that must be taken into account when building any power station.

Table 2 Number of employees for each type of energy

Type of energy	Employee factor Person/1 MW
Solar	2–3
Nuclear	3–4
Coal	3–4

Table 3 Comparison of physical capacity

Type of energy	Material consumption			Need to store energy	Need for rare materials
	Metal	Concrete (cement)	Reflective		
Solar energy "conversion into heat"					
Currently	15	300–1000	300–600	+	–
Future	15	400	200–400	+	–
Direct conversion to electricity					
Currently			1100		
Future			400	+	–
Nuclear	50–70	Materials		–	–
Fuel	40	800–900		–	–
Wind	260	500		+	
(in the sea)	200	1800		+	–
(on the land)	200	300		+	–
Thermal energy of the oceans	30	1800		–	–
bioenergy (organic)		100			

Table 4 Energy giving ratio

Type of energy	Energy giving ratio	
	Future	Present
Solar "conversion to heat"	0.3–0.5	0.1–0.2
"Direct conversion to electricity"	0.2–0.9	
Nuclear		0.13
Fuel		0.15
Wind		0.15
Oceans energy		0.1

As for wind energy, there is a clear difference between its stations being built on land or on shore, while sea and ocean energy is characterized by the need for huge quantities of building materials, minerals, and concrete materials; nuclear stations are unique in their need for rare materials, which are uranium or plutonium.

Energy Giving Ratio

Energy sources vary in their efficiency and the percentage of energy generation, as shown in the following table (Al-Alawi, 1999a; Bani-Younis, 1998; Fridkin, 1988; Hamakawa, 2003; Report about the need of the electrical grid, in the sultanate of Oman, for extra power generation to meet the growing demand in next years, 2003):

Solar energy occupies the first place among its counterparts in terms of the percentage of energy delivery (efficiency factor), as solar stations, especially through direct conversion, outperform all their counterparts from other energy sources. It is noted that the efficiency coefficients will rise in the future for solar stations due to the expected future progress in materials technology, and on the contrary, there is no indication so far of increasing the efficiency for other types of stations.

High Limits

There is no problem with the area of land used. If the population of the earth becomes ten billion, and each person needs 4 kW, or about 12 kW.h, then, by using stations at a level of 100 kW/km2, an amount of 400 thousand square kilometers will be required and this is only equivalent to 0.2% of the total land area. As for the need for materials used, it takes about 200 kg/year, per person, and this is less than 10% of the total consumption of materials. The coefficients for giving burned energy and weights will decrease in the future (Al-Alawi, 1999a; Hamakawa, 2014), which doubles the importance of solar energy and its exploitation, and Fig. 3 highlights the price of the energy generated in different parts of the world.

It is clear from Fig. 3 that the prices of the generated energy are inversely proportional to the amount of radiation falling on the unit area each year, as the price of the unit of electric energy decreases with the increase in the amount of this radiation. This indicator makes the Arab world a very suitable environment for the production of cheap electrical energy, as the radiation rate in most parts of the Arab world exceeds 2000 kW.h/m^2.year (Heinemann, 1998; Holttinen et al., 2007).

On the other hand, what is interesting is the remarkable decrease in the price of the energy produced with the increase in the power of the solar station. This is

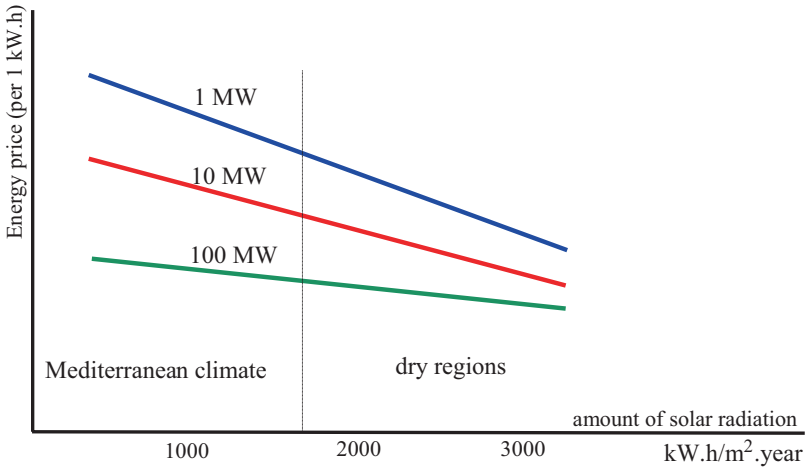

Fig. 3 Solar energy prices

justified by the low percentage of fixed foundation construction costs compared to the total cost and volume of production, and this explains the relentless pursuit of building giant solar stations.

Solar Energy in the Sultanate of Oman

The Sultanate of Oman is located in the far southeast of the Arabian Peninsula, extending between latitudes 16.40 and 26.20 degrees north and longitudes 51.50 and 49.40 degrees east, with an area of about 310,000 km^2, and a population of more than 4.4 million people (Website, n.d.). The Sultanate of Oman belongs to the hot, dry regions because it is located north and south of the Tropic of Cancer, and in the south, it has an extension of the tropical climate (Web Site, n.d.; Oman 98/99, 1998). It does so within the middle domain of the Arab world according to the division of solar radiation.

Because of this geographical location within the hot, dry, and desert regions, the amount of annual solar radiation falling on the Sultanate of Oman is so great that the establishment of solar stations in the Sultanate of Oman becomes particularly effective, and of acceptable economic feasibility. Table 5 presents the amount of annual solar radiation in one of the regions of the Sultanate of Oman (Masirah Island) depending on the angle of inclination of solar cells and on the different months of the year, while Table 6 presents the average amount of radiation and temperature in different months in the same region (Al-Alawi, 1999a).

Table 5 average monthly (Wm^{-2}) solar radiation falling on an inclined plane at different angles of inclination

Tilted angle $^{\theta}$	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Averg.
0	158	183	223	267	285	237	234	227	230	209	174	151	214
10	187	205	246	268	281	232	225	225	239	228	200	182	226
20	214	228	245	264	271	222	219	219	243	248	221	209	233
30	**236**	**235**	**248**	**257**	**255**	**209**	**208**	**211**	**242**	**265**	**237**	**232**	**236**
40	253	242	246	246	238	194	194	201	236	275	248	249	235
50	263	244	239	230	216	176	176	186	226	279	253	260	229
60	276	240	226	209	190	155	156	168	211	276	252	264	218
70	265	231	208	184	162	133	138	148	192	267	246	262	203
80	256	217	187	157	133	111	113	126	169	252	233	254	184
90	241	198	161	127	104	90	92	103	143	231	215	239	162

Table 6 Average monthly solar radiation and average temperature for different months

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
Inso ($kWhm^{-2}$ d^{-2})	5.66	5.64	5.95	6.17	6.12	5.02	4.99	5.06	5.81	6.36	5.69	55.57	5.67
T mean C^0	22.5	22.8	25.4	29	30.6	30.5	27.8	26.7	27	27.5	25.8	23.5	

A look at Tables 5 and 6 clearly shows that the amount of solar radiation falling on the Sultanate of Oman is much greater than its counterparts in Europe, which has been trying hard to exploit the available solar energy. Table 5 shows that the average amount of solar radiation in the Sultanate of Oman is more than 26 kW.h/year, while in all of Europe it is less than half of this number. And if we take into account that the rest of the Omani regions are hotter and drier than Masirah Island, this will enhance the option of building solar stations in the Sultanate of Oman.

Peculiarities of Exploiting Solar Energy in the Sultanate of Oman

Looking at the discussions and analyses in the previous paragraphs of this research, there are special features related to the exploitation of solar energy in the Sultanate of Oman, which we can summarize as follows:

- Huge amounts of solar radiation which are more than those in other Arab countries, while they are about three to four times their counterparts in Europe.
- The expansion of land areas, especially desert ones, reduces the importance of the necessary land areas indicator.
- The distribution of Omani villages and population centers over vast and remote areas increases the cost of the infrastructure needed to deliver electric power to them through the electrical network, as well as raises the cost of maintenance and the possibility of power outages, as increases the number of technical losses in transmission and distribution lines and a decrease in electric voltage along the transmission lines, which necessitates raising the voltage at the outputs of the generation stations (Facts, & Numbers, Ministry of Housing, Electricity,, & Water, Sultanate of Oman, 2003).
- The difficult geographical areas and the distribution of Omani villages among the mountains and hills scattered over the Omani areas, increase the costs of electrical installations in those areas.
- Most of the electrical stations in the Sultanate of Oman are thermal stations, and they use diesel and gas as fuel to produce this energy, and it is known that the sources of extracting this primary fuel are very far from the generation stations, and this means transportation costs for this fuel and the accompanying negative effects on the environment.

We can say that the first and second points strongly push for the construction of solar stations – especially large ones – in the Sultanate of Oman, which will strengthen the entire national grid, which can have positive effects. North of the city of Muscat, or on the beach, which will allow it to contribute to the desalination of seawater. The last three factors push the direction of building local solar stations in specific parts such as remote and rugged mountainous areas and remote desert areas. For this, the area of Wadi al-Jazi and parts of Haima are suggested in the central areas adjacent to the Empty Quarter, in the mountainous areas of the Musandam Governorate and Ibri at Al-Dhahirah.

Conclusions and Results

All types of fuel, including petroleum, are considered a major source of pollution, and thus pose a threat to our limited environment. As for (hydraulic) stations, they are considered a very clean source, but most of the water resources in the world have been depleted, and at the same time, they require huge amounts of money to establish the primary foundations, as well as electrical extensions and distribution systems over long distances. For all of the above and other reasons, it was necessary to turn to alternative renewable energy sources, especially solar energy.

This research has presented the most important global experiences in the exploitation of renewable energy. This analytical study made a general and comprehensive comparison between renewable energy sources in terms of energy prices, materials used, required land, used labor, negative impact on the environment, and efficiency coefficients. This research dealt with solar energy in the Sultanate, which can be an alternative and effective source of energy. This research discussed the most important characteristics related to solar energy in the Sultanate of Oman and proposed optimal locations where solar stations can be built.

This study, also, draws the researchers' attention to the close relationship between energy, environment, and water, especially in the Arab world with scarce water resources. Here we get the following results:

- Renewable energy sources are the best and safest solution to the expected energy crises in the world in the short and long terms, and solar energy is one of the cleanest types of energy, and it is most common and widespread in the Arab world.
- The Arab world, especially its central region, focuses on collecting solar energy, and it is one of the greatest areas of receiving this type of energy.
- The thermal and climatic variation between the three regions of the Arab world will contribute positively to the exploitation of solar energy, as this will lead to electrical integration, lower prices, increase the stability of the electrical network, and reduce interruptions. The countries of the Arab Gulf, including the Sultanate of Oman, located between latitudes 15 and 35, are among the regions in the center of the Arab world, which enjoy the highest amount of radiation in the world, and this is what makes research related to solar energy particularly rich and valuable.
- The amount of solar radiation in the Sultanate of Oman is 3–4 times that of Europe, which would raise the efficiency of solar stations to more than 25% and reduce the prices of energy generated, and this heralds a promising future for solar energy in the Sultanate.
- There are geographical and social factors in the Sultanate of Oman that encourage the construction of local solar stations to serve the dispersed population centers.
- Solar stations need large areas, and this is one of its most important negatives, which can be overcome in the future through the development of engineering materials used. The wide use of renewable energy sources in the Arab world will contribute to solving the escalating water problem, and proper planning for it will contribute to reducing pollution and preserving the environment.
- Wind energy is a new field of energy research, which must be focused on.

Recommendations

In conclusion of this research, and in order to optimize the use of renewable energy sources in the Arab World, the following recommendations are made:

- Forming a working group to develop the wind, solar radiation, and water atlas, and to provide documented information on biomass resources in the Arab world. And then implement practical experiments in various sectors, such as residential buildings, schools, and agricultural facilities, in order to fully or partially secure their energy needs.
- Establishing a data bank that gives researchers adequate information about the current and future energy needs of the Arab world, and automatically leads to an improvement in planning ability at the national level.
- Spreading scientific awareness of the importance of solar energy at the academic and applied levels and for the general public.
- Conducting training courses to train local cadres in cooperation with local and international expertise.
- Encouraging research in solar energy sciences and its applications.
- Creating the infrastructure for the transfer and development of the solar energy technology industry.
- Cooperation and participation with various local and international scientific bodies interested in developing solar energy.
- Allowing owners of solar, wind, and other renewable energy facilities to import the raw materials needed for industrialization exempt from taxes.
- Design and implementation of integrated solar energy systems.
- Develop media programs to create awareness amongst the citizens of the importance of renewable energies, and ways to benefit from them in an objective manner.
- Considering the last roof in multi-level buildings as the common property of all the occupants of the building, and therefore each of them has the right to install a solar heating device on this roof.

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Crafting Embeddedness in the Hospitality Industry

Furkan Araslı and Hüseyin Ilgen

Abstract This study provides a discourse on how hospitality employees' job embeddedness increases through the accomplishment of crafting their daily tasks. In hospitality, scholars expressed industry-related perceptions on the significance of job crafting, and implicated suggestions for effective work performance to occur – employees are to be enthused as operators of their own job crafting. A critical review of the literature revealed the scarcity of how job crafting influences job embeddedness. Based on this notion, processing self-attitudes and thoughts in order to reach targets and, consequently, existing schools of thought have disregarded the value of emotional attachment to the enterprise. Thus, through the lens of self-regulation theory, it is implied that adjustment of their proficiencies, aspirations, and inclination have imposed hospitality-specific optics within the latter of their duties (Wrzesniewksi A, Dutton JE, Acad Manage Rev 26(2):179–201, 2001). In practice, employees may practice job crafting to enhance their job performances to lessen insufficiency with tasks and can ease the complexity of jobs. The focal point of existing job crafting literature has been employees' views about how to craft their tasks.

Keywords Job crafting · Job embeddedness · Self-regulation theory · Hospitality

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Introduction

The hospitality business draws a large number of new entries in touristic cities and nations, which boosts competitiveness in the market. Hotels have a vast choice of products, but the most important consideration in determining which hotel is best for visitors is the level of service they provide. With this in mind, frontline personnel must go above and beyond to ensure that guests have an amazing experience and are completely satisfied. Perceived Coworker - Supervisor Support (PCSP) refers to the actions of personnel who engage in these kinds of activities (Rank et al., 2007). Employees do these acts of their own will, and they are long-term in nature. This consistent and selfless effort to meet the demands of customers is entirely voluntary (Kucukusta et al., 2013). Job embeddedness, a measure of how much an employee is interested in his or her work, is a factor that is affected by PCSP (Harris et al., 2011).

In order to meet the demands of customers, hospitality employees must go above and beyond their customers' expectations in order to give them excellent, satisfactory service (Barnes et al., 2016). Employees' pleasant interactions with customers form the basis of customer service attitudes. Studies on customer service have been published several times, and all of them agree that customer service acts boost customer happiness and service quality (Tsaur et al., 2014).

Workers in the hospitality industry must be able to organize and carry out their job responsibilities effectively due to the high volume of contact they have with customers. The hotel business relies heavily on job design (Kim et al., 2018). Those who operate in this industry may better appreciate the significance and purposes of their work if they have their jobs custom-crafted. This will motivate them to do their best work and increase their productivity. Because of this, staff's actions toward consumers are affected (Cheng & Chen, 2017).

One of the most significant subjects in management literature has been the effect of work resources and expectations, as well as the work environment, on employees' levels of job enthusiasm (Permarupan et al., 2013). It also influences work satisfaction, workplace engagement, burnout, proactive behaviour, and performance and tiredness (Teng, 2019). Wrzesniewski and Dutton (2001) described job crafting as the duration in which employees engaged actively to alter the borders of their jobs. This can be due to a change by employees as a reaction to an alteration in job objectives (Griffin et al., 2007). The three classifications of job crafting as described by Wrzesniewski and Dutton (2001) are task crafting, cognitive crafting, and relational crafting. Furthermore, Bardi (2011) described a task as a peculiar activity or work. For example, the task of a receptionist or front desk personnel in a hotel is specifically to deal with guests, receive payment from guests as well as guest check-in/check-out. Studies have shown that task crafting involves altering the successive, physical cases or behaviours in an organization, which includes giving up or keeping tasks, restructuring tasks, and regulating the impacts of time spent on the tasks (Wrzesniewski & Dutton, 2001).

Job crafting gives another meaning to work because the shaping of cognitive tasks and relationships in the organization would allow employees to conduct their work differently resulting in reshaping the goal of their jobs (Wrzesniewski & Dutton, 2001). When immigrant hotel employees have the opportunity to craft their jobs by using job resources and challenging job demands, they can improve the fit between their personal needs, abilities, and passions about the job (Tims & Bakker, 2010). Hence, when crafting their job, such employees may demand more responsibilities from their supervisors, may sacrifice their priorities for completing jobs, may develop close links with colleagues by requesting their advice and aid, and may accept job demands when they sense these demands as a way for advancement and improvement (Tims et al., 2012; Vogt et al., 2016), and may enhance their perceptions of fit, links, and sacrifice. That is, Job Embeddedness can be a potential consequence of enhancing job resources and challenging demands through job crafting.

In empirical terms, several studies have to date investigated the effects of job crafting on several employee outcomes, such as work engagement (Bakker et al., 2012; Karatepe & Eslamlou, 2017; Tims et al., 2013; Vogt et al., 2016), job satisfaction (Kim et al., 2018), and burnout (Cheng & Yi, 2018; Demerouti et al., 2001) and job performance (Tims et al., 2015). Furthermore, drawing on the Job Demands-Resources theory, several scholars have revealed a significant relationship between the number of job resources and the level of work engagement (Mauno et al., 2007; Xanthopoulou et al., 2007).

Background

Job Crafting

People are said to "job craft," according to Wrzesniewski and Dutton (2001), as the physical and mental adjustments they make in the workplace in order to make their work appear more important. Task, relational, and cognitive crafting strategies are all included in these job-change re-creations. A task is said to be "crafted" when a fresh approach is taken to completing it. Job tasks are restructured in order to accomplish this. To deal with the quantity and quality of communication between co-workers, relational crafting is needed. Cognitive crafting deals more with how an employee sees and defines his or her role at work.

There has been some debate as to whether or not some behaviours constitute job crafting, according to a recent study led by Zhang and Parker (2018). As an example, Tims et al. (2012) stated that job crafting may also take the shape of skill development in addition to cognitive, relational, and task modifications. That's not the case according to Demerouti (2014), who noted that task and relational crafting may be considered as modifying social resources and that merging those three forms of crafting cannot be done directly.

On the other hand, it is widely accepted that cognitive craftsmanship is not a kind of job-creation (Zhang and Parker, 2018). Cognitive crafting, according to Wrzesniewski and Dutton (2001), helps employees better understand their work and their work identity. Researchers have argued that cognitive crafting is a passive adjustment to the work environment, which has no significant impact on the job's content. They have so devised new job-creation strategies that include all of the known knowledge and ambiguity into their offers. They've distinguished between two types of job crafting: approach crafting and avoidance crafting, and they've highlighted why each is important.

As opposed to certain scholars, cognitive crafting is undeniably one of the most essential job-creation approaches (Niessen et al., 2016). An individual's vision of their work and task is aided by this strategy, which is self-initiated and deliberate. In comparison to other kinds of crafting methods, this one is more ethereal, yet it is crucial for individuals to affect the meaning of their work, their identity within the organization, and their feelings (Berg et al., 2013). Employees' experiences, relationships, and the way they build their perceptions are all part of cognitive construction. When a person broadens his or her employment scope or role direction, he or she is engaging in cognitive crafting (Parker, Wall and Jackson, 1997). This is a result of employees' deliberate and active efforts to provide significance to their positions and responsibilities.

Another form of crafting is 'avoidance crafting' and includes such behaviours as escaping and avoiding the worst aspects of employment. In the same way as approach crafting benefits can be resource or demand-driven, avoidance crafting can be framed as either behavioural or cognitive.

Job crafting approaches are classified in a variety of ways, as can be observed in the scholarly literature on the subject. To address the obstacles and limits of the workplace, Bruning and Campion (2018) developed two new job-creating scopes: role crafting and this concern for difficulty. In contrast, Tims et al. (2012) developed resource crafting, which is concerned with increasing job resources and meeting the requirements of the work.

Even though the majority of studies indicate that job crafting has a favourable relation to work engagement, other research suggests that job crafting has a negative relation to work engagement (Demerouti et al., 2015, Petrou et al., 2012). These findings can be explained by the fact that employees try to reduce the pressures of their jobs by withdrawing, and as a result, they show less passion for their work. Employees' energy levels may drop as a result of job crafting since it demands them to regulate their own behaviour in order to alter their working conditions. Berg, Grant, and Johnson (2010), on the other hand, asserted that work crafting is associated with elevated levels of stress, dissatisfaction, and the occurrence of random emotions of unease. As a result of arguing with coworkers, a lack of job responsibilities might lead to a lack of interest in one's work (Tims et al., 2015).

In the words of Wrzesniewski and Dutton (2001), finding meaning in work is a key motivation to begin job-making. According to Bakker and Oerlemans (2019), when people create their social resources, they feel more connected to their job and are better able to communicate with others. More often than not, when people apply

to craft approaches to their structural resources, they find themselves in positions of greater competence and responsibility. For instance, employees who actively seek out possibilities for professional growth are better able to do their daily responsibilities (Rudolph et al., 2017). In addition, when employees want greater adaptability and variety in their work, they instantly feel more in control of their own destinies (Tims et al., 2013). They also feel more in charge of their work when they have more control over their resources and lesser expectations. As a result of reducing their burden and removing obstacles, employees feel more empowered and have more options when it comes to their work.

Employees who are proactive in their search for new opportunities are more likely to find rewarding and challenging positions (Bipp & Demerouti, 2015). In addition, those who have the tendency to stay away from bad situations are more likely to be able to reduce the amount of work that gets in their way. Job crafting approaches may be utilized by promotion-oriented people to seek out resources and challenges, whereas prevention-oriented people are more likely to reduce negative job demands (Brenninkmeijer and Hekkert-Koning, 2015). People who have a happy outlook on life are more likely to engage in job-creating activities, according to these findings.

Intangible work responsibilities are also affected by promotion-focused job crafting. Employees that successfully implement this sort of practice have a mindset that they constantly approach situations from a positive perspective (Brockner & Higgins, 2001). Intangible work positions benefit from promotion-focused job designing since both job resources and demanding job demands may be altered. Reactions like this accumulate over time and have a favourable impact on workplace attitudes as well as the emotional and physical well-being of employees (Burić and Macuka, 2017). Positive sentiments help people build cognitive personal resources like optimism, according to Xanthopoulou, Bakker, and Fischbach (2013), and this helps them stay focused at work. With this form of job crafting, individuals construct their work into a meaningful and significant position, and they generate engaging duties as well as establish strong relationships as a result of this process.

However, people face real challenges in their professional roles that they cannot readily change (Wood and Michaelides, 2015). In fact, this case demonstrates that a preventative approach to employment creation might be ineffective. So why does the work feel more exhausting? Because employees put in so much effort and time to avoid unfavourable events from occurring. In addition, employees avoid some responsibilities and connections by focusing on prevention. As a result, employees will be burdened with an increased amount of work and responsibility.

Despite the fact that employers create jobs, employees are the ones who customize them to fit their unique set of talents and abilities. It's done by the workers themselves in order to tailor the job to their own specific preferences and needs. Managers have a difficult time establishing assignments that are acceptable to their employees (Grant and Parker, 2009), but employees may take control of the process by redefining the requirements for themselves through the use of job crafting. Employees can tailor their responsibilities to fit their personality types through the

use of job crafting, which doesn't affect the nature of the work itself (Bruning & Campion, 2018).

Job crafting, according to Afsar, Masood, and Umrani (2019), allows individuals to change the way they work, collaborate with coworkers, and view their work environment. Taking a step back and looking at the broader picture, these behaviours really help an individual perform better and enjoy their job more. Both individuals and organizations can benefit from implementing creative work behaviours, which include a wide range of actions made to improve the workplace. Performing more crafting behaviours results in more innovative ideas for completing tasks, as can be shown plainly. The more resources a person has to succeed in their job, as stated by Kim et al. (2018), the better their chances are. Individuals can reduce their level of boredom and dissatisfaction if they are given the flexibility to design their work to their own specifications. With the ever-changing nature of work, this might help people adjust (Afsar, Masood and Umrani, 2019). When it comes to developing and carrying out new strategies, job-creation is a benefit for individuals (Petrou et al., 2012).

The workplace has become increasingly focused on job design, which demonstrates how people manage a variety of job characteristics in order to accomplish their duties in a more efficient manner (Morgeson and Campion, 2003). People are taking responsibility for their job and proactively modifying the characteristics of their responsibilities, which indicates that workers are taking charge, not being hesitant to express their problems, and asking for feedback (Parker and Bindl, 2017). Many studies show that workers' work lives are improved when they exhibit these behaviours.

Tims and Bakker (2010) said that employees are proactive in reducing their job expectations or searching for more resources. Individuals that engage in job-creating behaviours in the workplace are more likely to be successful at their jobs. The reason for this is that a more relaxed work environment encourages people to become more engaged in their work, which in turn leads to increased productivity (Tims et al., 2016). As a result of job crafting, an individual's job resources improve, and so does his or her personal wealth as well. JD-R theory states that resources aid in performance development.

In the context of job crafting, Bakker et al. (2020) suggested that employees might participate in fun work design. Fun and enjoyable goals may be achieved through a system of playful work design without modifying the job itself (Scharp et al., 2019). When duties are redesigned to be more fun and engaging for employees, this is known as "playful job design" (Fluegge-Woolf, 2014). Individuals in the workplace might avoid boredom by establishing goals and participating in a fun competition.

Job crafting is based on the idea that people should recreate the physical and emotional circumstances of their jobs. Training and development possibilities can be found by enhancing one's job resources. Social job resources will lead to more people seeking aid and collaboration. Working on new processes and programs in the business implies taking on more demanding duties, while avoiding jobs that are too unpleasant and might stifle progress (Teng & Chen, 2019).

According to Teng (2019), it is possible to construct one's job by one's desire to do so. A person's self-identity is the source of their passion. In order to be motivated, people need to believe that their work has a purpose and that they can make a difference in the world (Vallerand et al., 2014). As a result, workers are only as committed as they want to be.

It is stated that job crafting encourages individuals to develop their own methods for tailoring work design to their interests and abilities. Three strategies were presented by Berg et al. (2010) in order for employees to cultivate job passion through job crafting. By taking on new duties and altering their own work-related accomplishments, they are saving time, effort, and attention for themselves. Employees may discover and follow their employment interests by redefining their job content and modifying their interactions with the people around them.

Job Embeddedness

Linking, sacrifice, and fit are three of the non-attitudinal work and non-work influences that make up job embeddedness. These are the unseen ties that bind people to the company. Employee commitment to the company is assessed using the organizational embeddedness metric. This has a direct correlation to the conditions of the workplace. In the workplace, these ties would include managers, colleagues, and even business partners. When an employee has more and stronger connections to the company, he or she is more entwined with their work. The term "job-fit" relates to a person's comfort level and sense of belonging inside a company. Having a good fit occurs when an employee's personal beliefs, career goals, and aspirations align with those of the company, or when an employee's abilities, expertise, and characteristics align with the needs of the position. To put it another way, sacrifice refers to the psychological benefits you may lose by quitting the company, such as monetary compensation or the use of your own office (Chan et al., 2019).

Surie and Ashley (2017) showed that job embeddedness is a predictor of employee turnover intentions or retention. In today's workplaces, job-embeddedness is leading to a high rate of turnover (Halbesleben & Wheeler, 2008). According to Jiang and Law (2013), people's view of fairness will increase their loyalty to the company. Fairness and accuracy in the workplace require a system of long-term justice (McFarlin & Sweeney, 2014).

Coetzer et al. (2017) noted that small and medium-sized enterprises (SMEs) are well-known for their casual "word of mouth" recruitment approaches, and new employees will feel right at home in these organizations. This is especially true given that some of these new hires were recommended by former workers. In addition, employees in small and medium-sized businesses (SMEs) frequently swap responsibilities with their co-workers, which provides them with the opportunity to learn flexibility and improve their skills through a range of assignments (Wilkinson, 1999). If not put to use, all of an employee's abilities and expertise might diminish, thus many who work in these companies choose to keep their jobs since the tasks

they perform are dynamic (Gialuisi & Coetzer, 2013). As a result of adequate training and coaching, all hotel workers will be fully immersed in their job.

It is more probable that a worker may experience job embeddedness if they are motivated to look for new chances, consider adjusting to changing needs, maintain their skills, and have confidence in their talents. When employees' career flexibility is higher than the medium level, as recommended by Savickas (2005), they will search for metrics to help them plan their careers.

According to the literature, job embeddedness has a significant impact on people's work habits. There is, however, a lack of study on the abilities needed to cultivate a sense of embeddedness in the workforce by companies (Woo, 2018). As a result of their career flexibility, people are more likely to display a high degree of job attachment. Individuals with high degrees of professional flexibility, according to Zacher (2015), are better able to handle the job and career-related claims. Resources for career adaptability improve the integration of employees with their surroundings since their views are self-regulated and they notice the congruency between themselves and their surroundings. With career control, people may make better decisions about their job roles and responsibilities since they have more influence over them (Job crafting). Employees' career confidence is another factor that, regardless of the challenges they confront, they will be able to overcome (Al-Ghazali, 2020).

Employees that are more committed to their jobs are more likely to come up with fresh ideas because of their increased sense of purpose. Previously, researchers focused on the link between job embeddedness and innovative work behaviour and concluded that the community in which workers reside had a greater impact on their inventive behaviour than the organizations they work for. Nonetheless, the community dimension of job embeddedness is sufficient for predicting future job behaviour (Singh et al., 2018).

Everyone needs to be content with their lives. Especially for those who work in high-stress environments that sap their reserves of willpower and stamina. That being stated, the term "life satisfaction" refers to the mental process of evaluating one's own level of contentment with one's lot in life in light of one's own standards (Diener et al., 1985). People's life pleasure has been interpreted as their ability to perform successfully at work (Erdogan et al., 2012). For example, people who are happy at work because of the cognitive conditions they have in place may regard their well-being as a valuable resource, and so they seek to maintain it by not quitting the company (Hobfoll, 1989). As a result, Susomrith and Amankwaa (2019) discovered that employees that are well-integrated into the company's culture exhibit more innovative work behaviours, and that this relationship between employee happiness and innovative behaviour is even greater.

What it means to be creative is to come up with new ideas that might have a beneficial impact on an organization's performance, and these new ideas often include changes and activities that may be distinct from existing concepts (Sternberg, 2006). Creative performance, on the other hand, refers to the ability to come up with fresh solutions to workplace issues (Carmeli et al., 2013). The notion of work embedding may be used to examine the relationship between job embeddedness and

creative performance. People that have a high degree of embeddedness in their jobs tend to get involved in the day-to-day running of the company and speak openly with their coworkers. Participants in brainstorming and idea-sharing sessions will be more creative (Karatepe, 2016).

In Swider et al. (2011), they found a high correlation between supervisor support and the level of job embedding. When it comes to job embeddedness, Treuren (2019) stated that workers' personal aspects have an important role.

Numerous studies have shown that professional performance is a combination of knowledge, motivation, and competence (Bergiel et al., 2009). Workplaces demand long-term productivity, engagement in the company's goal attainment, and sustainable work results from its personnel (Mitchell et al., 2001). Job embeddedness allows for these possibilities, and one method to achieve the embedded state is to be pleased with one's current position (Bibi, 2018). According to Zeffane and Bani Melhem (2017), the concrete features of the workplace, such as advancement chances, supervisors, co-workers, and job-related duties, are what contribute to job satisfaction. Job embeddedness, unlike job satisfaction, considers not just work-related elements but also the social situations of employees. Feeling good about yourself is a direct result of getting what you want (Shah et al., 2020).

Embedded workers are more likely to strike a work-life balance and, as a result, are happier in their jobs (Safavi & Bouzari, 2019). People who are well-embedded in their jobs have an unseen force holding them back from quitting. This invisible force grows stronger as the employee grows in his or her career. Because of this, quitting your job will be more difficult. Stronger forces at work help people become more integrated into their jobs, which, as previously indicated, may help employees form close bonds with co-workers, build shared ideals with the organization, and take pleasure in being part of a larger group. Employees who exhibit all of these traits may come to believe that quitting their work would require an enormous amount of self-sacrifice (Al-Ghazali, 2020). When an employee achieves professional success, they feel a sense of belonging to the company and a sense of pride in their job. It has been shown that employees with low levels of job embeddedness are more likely to show signs of turnover (Murphy et al., 2013). When employees have a poor relationship with their employer, they are less happy with their work and more likely to look for a new job. With their thorough understanding of their profession and the company they work for, embedded workers may achieve their personal objectives more quickly and easily.

People who are happy with their lives and their careers are more likely to consider their careers to be successful, and it is apparent that happiness in life is influenced by the degree of social integration and the quality of one's immediate social surroundings. In order for an individual's talents, values, and demands to align with those of a company, it may take time. As one develops strong social ties and personal connections, it is almost probable that job embeddedness will begin to emerge. It's not simple to get to this level, and it won't happen quickly either (Afsar & Badir, 2016). Individuals consider the benefits and drawbacks of work embeddedness before deciding whether or not to continue in the company. As a result, they are more concerned with protecting their resources than letting them go.

On the other hand, off-the-job embeddedness expresses features of employment embeddedness that are not directly related to the workplace environment. A worker's non-work relationships, such as family, friends, hobbies, socializing, and many others, might cause an employee to become emotionally and psychologically entangled in the position (Zhang et al., 2012). It's more probable that someone with several connections may leave their current work if movement between on- and off-job regions disrupts the ties. For this reason, non-work situations are regarded as being in harmony with the concept of "non-work." People's routines are badly affected by a variety of factors, including their surroundings, situations, and personal interests. They are also adversely affected by work changes (Chan et al., 2019).

According to Mitchell et al. (2001), one characteristic of embeddedness can have an effect on others. Employees' lives are enriched when they form relationships outside of work, and this has a ripple effect on their professional relationships. To illustrate this point, let's say that an employee who is energized by their non-work life is more inclined to interact with co-workers and participate in office activities. Emotional weariness, on the other hand, might have a negative impact on one's ability to interact with co-workers and participate in office activities.

Employees who take care of their personal lives outside of work show that they value their relationships with friends and family and make time for their hobbies and interests (Mitchell et al., 2001).

Hotel workers have a tough time organizing their schedules because of the nature of their jobs. Consequently, as Chiang et al. (2010) said, hospitality employees are subjected to significant levels of emotional fatigue. Work-related stress can lead to emotional tiredness, which can cause employees to distance themselves from the company if their bosses expect them to put in long hours every day (Cole & Bedeian, 2007). The ability to avoid emotional exhaustion in workers has been demonstrated by providing them with a high LCWH through the maintenance of on-the-job connections and fit (Karatepe, 2013).

An important role that job-embeddedness has played in several researches has been to act as an intermediary between various factors. According to Lyu and Zhu's (2019) findings, job embeddedness serves as a mediator between workplace ostracism and employees' intentions to stay or leave. Job embeddedness also has an impact on family and colleague support on performance, according to Karatepe (2016). People's work efficiency can be influenced by their job embeddedness, according to Tian et al. (2016). According to the principle of job embeddedness, when an employee shows a strong fit with the company, he or she puts in more effort to stay in the company by performing well and pursuing goals. Job embeddedness impacts career success through career adaptability.

The term "felt obligation" refers to the concept that employees have a moral obligation to care about the success of their employer and to aid in achieving the company's goals (Eisenberger et al., 2001). Individuals that receive a favourable response from the organization demonstrate large levels of "felt duty" and are more willing to work for the good of the company. According to Bolino et al. (2012), obliged individuals regulate and begin behaviours that are beneficial to the

company. These actions might include enhancing contact with co-workers or taking on additional responsibilities that help workers feel more connected to the company.

According to most published studies, job embeddedness has good outcomes. A few studies have examined the downsides of employment embeddedness (Allen et al., 2016; Burton, 2015; Sekiguchi et al., 2008). When employees have contradicting experiences at work yet are firmly ensconced in the organization and unwilling to quit, they begin feeling imprisoned and worried. According to Allen et al. (2016), those who are immersed in the organization are more likely to have strong job-related links and so are more likely to be committed to the institution. Because of this, it becomes more difficult for them to quit the company. Individuals, on the other hand, may face adversity. Embeddedness has many advantages, yet it can also lead to resignations due to workplace issues (Peltokorpi, 2020). People are inclined to stay in the organization even though the situation is uncomfortable since they are unwilling to resign.

Conclusion

Individuals may benefit from a role-based view where task and relationship crafting are put, but a resource-based perspective does not really care about enhanced efficiency, as demonstrated by the correlation between this crafting approach and work experience, such as job satisfaction (Tims et al., 2016). Later, Bruning and Campion (2018) came up with an approach and avoidance acts as two contexts for job-creating behaviours. In contrast to avoidance crafting, approach crafting focuses on fixing problems, improving the work environment, and perceiving workplace pressures in a more positive light. When it comes to the creation of new jobs, Bipp and Demerouti (2015) used the JD-R technique, and they found that people who were more likely to employ this strategy had more job resources and were better able to handle more difficult tasks. Because of this, it may be concluded that these employees at work were purposely given more resources and difficulties to help them grow. These employees were, however, more likely to be involved in lowering the burden of their jobs by minimizing some aspects of their work (Lazazzara et al., 2020).

It has been demonstrated that tailoring work to the preferences of the individual results in a better match between the two parties (Oldham & Hackman, 2010). To put it another way, when employees look for resources that are tailored to meet their own interests and requirements, they develop both internal and extrinsic motivation (Halbesleben, 2010). Job making is a great way to improve workers' abilities since it introduces new things and experiences into their daily routines. However, it has been found that reducing the demands of work might lead to a decrease in motivation (Rudolph et al., 2017).

Job crafting, according to self-reports by workers, has been linked to better work engagement, employment stability, as well as better job performance, according to Tims et al. (2012). It was later reported by Tims et al. (2013) that job crafting has a good impact on well-being, such as a reduction in burnout and increased job

satisfaction, through an enhanced office environment. Increased work expectations have been demonstrated to increase employee engagement and decrease job burnout. There was no correlation between the reduction in job requirements and the well-being of workers (Vogt et al., 2016).

Job-creation changes are associated with dissatisfied work engagement, according to Petrou et al. (2012). The more people sought employment resources on a given day, the more involved they appeared to be in their work. It was revealed that the more people minimized their work-related hindrances on a given day, the less engaged they seemed on that day.

According to the self-determination theory, people have an innate need for three types of psychological needs: a sense of belonging, a sense of control, and a sense of competence (Ryan & Deci, 2000). Autonomy refers to a person's desire to act in accordance with their own desires (deCharms, 1968). Individuals who want to be competent while functioning in a certain setting are referred to as competent (White, 1959). The proclivity to interact, connect, and show concern for others may be shown in one's relatedness (Baumeister & Leary, 1995). Extensive research has shown that when these three requirements are met, individuals' well-being and work performance improve, but a lack of these needs results in a decrease in performance and job stress (Gagné & Vansteenkiste, 2013). Creating a job description and looking for resources are two ways to be present in the work life of your workers. It is more likely that the workplace will meet the needs of employees' competence, relatedness, and autonomy if they design their own occupations. There is a belief that people who understand how to construct their employment are happier and more interested in their work.

The authors Brockner and Higgins (2001) asserted that self-management may be divided into two categories: promotion-focused and prevention-focused. In order to meet their own goals and aspirations, those who are self-focused on promotion are more aware of their own personal growth and development requirements (Higgins, 1997). As a result, people with this mentality tend to place a high value on their professional accomplishments. Achieving goals is a way of life for some individuals.

On the other side, self-management, which focuses on preventing bad outcomes, implies that individuals have a strong desire to avoid situations in which their needs are not met. This sort of employee is constantly looking for methods to cut their losses at work. Because of this, it is possible to say that self-management that focuses on preventing problems is really preventing them from occurring. In the workplace, for example, people may strive to lessen the stress of their jobs to prevent being demotivated (Tims et al., 2013).

Throughout the course of a person's career, there are a number of clearly defined borders. Boundaries in the workplace are mostly determined by a person's job position, and when that role can be altered, the previously described promotion-focused job construction strategy can be effective. It eventually leads to positive changes in the lives of employees, such as increasing the difficulty of their jobs and giving them additional employment resources. It's well-established that increased work pressures promote personal development (Ryan & Deci, 2000). Individuals' psychological requirements for self-determination can be satisfied by additional

employment resources. As a result of having greater resources, employees are less likely to put in the effort required to complete a given task, which in turn reduces the likelihood of job burnout (Bang & Reio, 2017).

People with a wide variety of resources are more likely to engage in job-creation activities (Chen, 2019). Job resourcefulness and a proactive attitude, on the other hand, impact job creation. To be more resourceful, employees actively seek methods in which to develop their circumstances, and so display job-crafting activities (Teng & Chen, 2019).

Conservation of Resources theory suggests that when people think that they may gain more concrete and moral interests by staying in the organization, they become more invested in their job and display extra-role acts like creative performance and other good behaviours (Hobfoll & Shirom, 2001). Individuals who are fully immersed in their professional duties appear to have a good match with the job and organization. As a result of this state, their creative output also rises (Rahimnia et al., 2019).

From a different lens, self-regulation theory regards to "the flexibility and adaptability of human behaviour, enabling people to adjust their actions to a remarkably broad range of social and situational demands" (Baumeister & Vohs, 2007, p.1). Studies with this lens have delved into the adjustment of hospitality employees and their proficiencies where their aspirations and inclination have imposed hospitality-specific optics within the latter of their duties (Baumeister & Vohs, 2007; Fan et al., 2022; Miao, 2014).

Level of control over work hours (LCWH) is an indicator of task flexibility and control, according to Chan et al. (2019) found that it can be a precursor to both on- and off-the-job embeddedness. For those who work in the hotel industry, long hours and national holidays are commonplace. As Valcour (2007) pointed out, unpredictable working hours in the industry make it even more difficult for people to reconcile their job and personal life. Individuals' relationships with their loved ones are jeopardized or harmed as a result of this predicament. However, those who have more flexible or regular working hours would have more time to participate in non-work activities. Due to the increased socialization that would result from participating in such activities, employees would develop deeper links to the non-work environment (Moen et al., 2008). In addition, Richman et al. (2008) said that those who are able to work from home have a better fit in their non-work environments.

Employees' concentration on acquiring and saving resources helps to explain why people become entrenched in a work and how they behave when they do so. Resource loss is the most critical consideration in Conservation of Resources (COR) theory, hence preventing it is more critical than obtaining it (Halbesleben et al., 2014). Another interesting finding is that Mikolajczak et al. (2007) found people who exhibit emotions in line with what is expected of them tend to hold on to more positive emotional resources, which in turn has a favourable impact on the way they behave when providing service. Certainly, the contributions of scholars have laid the foundation for all exemplified studies and the knowledge economy generated on the matter of job crafting and embeddedness. For future studies, the development consideration of theories, like self-regulation theory, may help shed light on the

unknowns of this matter. Multi-level considerations with the cross-interaction investigation on the role of the supervisors and climatic factors may be considered. Therein, theories and studies presented in this chapter have, in general, aimed at resource losses (i.e., personnel). Additionally, a relationship between psychological capital and customer-related obstacles may expand present understanding in hospitality emotional research.

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The Impact of Microfinance on Economic Growth: Evidence from the Gulf Countries

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Abstract This article investigates the impact of microfinance on economic growth in the Gulf countries using annual data from the World Bank database between 1990 and 2020. A panel data analysis is used to run the regression model via pooled OLS. Results reveal that Microfinance is significantly and negatively associated with economic growth, while market capitalization positively impacts the growth. Therefore, financial services provided by the stock market may promote economic growth rather than Domestic credit provided by the banking sector.

Keywords Economic growth · Microfinance institution · Market capitalization · Microcredit · Investment · GCC countries

Introduction

Microfinance is an instrument to enable the poor and disadvantaged to start their own business to survive in society, lift themselves from poverty, and save something to fulfill their basic and future needs. Moreover, microfinance products enable poor people to set up income-generating activities that ultimately provide income for their domestic consumption. Therefore, the intervention through microfinance has a substantial positive impact on the lives of society in general and the poor people in particular (Sultan, 2017). Moreover, microfinance institutions provide outstanding and various products and allocate funds through different levels via financial intermediaries who help increase individuals' and households' access to the funds to start up their businesses, which accelerates economic growth (Khalaf & Saqfalhait, 2019).

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About 10.7% of the world's population lives on less than $1.90 a day (World Bank Group, 2018). Thus, Microfinance Institutions (MFIs) offer several financial products and services to the poor and disadvantaged who cannot access financial resources. The services include microloans without collateral, investment management, electronic services, and deposit insurance among the services available. In other words, the microfinance term indicates small financial services for individuals who may not usually reach credit and deposit services, previously known as microcredit. Microfinance is now well known in the literature and continues to sprout identities that suggest similar services such as micro-savings, microinsurance, and mobile banking (Fadahunsi & Barake, 2018). However, Microfinance Institutions encounter significant challenges on their way to financial sustainability; financial inclusion, information asymmetry, and outreach are among these issues. Much literature covers these topics (Randøy et al., 2015; Strøm et al., 2014).

Indeed, the financial sector is the engine force of a nation's economic growth, and the banking sector plays an outstanding role. In this context, lending activities to individuals, small projects, and industries are crucial in accelerating economic growth and decreasing poverty, specifically in developing countries. The idea of microfinance (microcredit) was initiated by Muhammad Yunus, who is a Professor in Economics from Bangladesh, in 1970, which gained him the Nobel Peace Prize in 2006, and the Presidential Medal of Freedom in August 2009 by the US President. Since then, it has developed into a global movement with significant momentum drawing attention to its fruitful lending to household and small projects and poverty alleviation (Masih, 2016).

Access to sustainable microloans aims to reduce poverty by creating new jobs, earning an income, and allowing poor people to make the best decisions (Ahmad Mashal, 2016). Moreover, the microfinance sector in Arab countries has risen rapidly over the last two decades, but it is still constrained by a shortage of proper regulations and ineffective structures. So yet, no enabling legal, regulatory, or institutional environment specific to the microfinance sector has been established (Khalaf & Saqfalhait, 2019). Although the Arab microfinance sector lacks structure and guidance, such institutions encounter judicial and regulatory obstacles. Moreover, they are underserved markets that do not provide a comprehensive variety of demand microfinance services, microfinance institutions (MFIs) might be able to attract more clients and maintain their interests.

According to the International Monetary Fund, in 2018, the activities of finance businesses are still small in the Arab Gulf Countries and had around 80 microfinance institutions, with an overall loan portfolio of approximately 3% of GDP. Their loans are focused primarily on real estate, small and medium enterprises, and individual and microcredit loans. Nevertheless, Non-performing loans (NPLs) have risen recently in the UAE, Saudi Arabia, and Oman, reaching 12.8%, 10.3%, and 5%, respectively. While the regulatory frameworks for finance institutions seem adequate in most GCC, scarcity of public awareness and increased funding costs; are among their main obstacles. In addition, the majority of their funding comes from debt and paid-up capital, putting them at a disadvantage compared to banks

that have access to interest-free deposits. Moreover, except for the UAE, none of the GCC countries allow microfinance institutions to accept deposits from customers. However, Oman recently began allowing finance companies to raise six-month term deposits from corporations to alleviate corporate funding pressures.

The Financial inclusion concept is best demonstrated by expanding microloan activities in developing countries. However, financial institutions are generally hesitant to lend to low-income people; while households in the gulf countries have adequate access to banking services, they have limited access to loans (Khalaf & Saqfalhait, 2019). In this context, it is worth studying the extent of the microfinance industry's contribution to economic growth in Gulf countries (GCC) and exploring the impact of Microfinance on a significant component of inclusive economic growth in Gulf countries. Moreover, GCC is considered to be an oil-based economy, and they work on diversifying their economies, but this matter demands an efficient financial system, and microfinance institutions are deemed to be one of its tools.

Although the existing literature on Microfinance in Arab countries is limited, this paper intends to demonstrate the importance of microfinance in the gulf region and how relatively microfinance influences economic growth. The findings of this study, together with a deeper understanding of MFIs' impact on economic growth, will give policymakers some valuable insights that they can use to develop appropriate regulations and encourage financial institutions to expand their micro-lending activities.

The Economic Outlook in GCC Countries

According to new research (International Monetary Fund, 2021), the GCC economies suffered severe but temporary recessions. As a result, growth in the GCC economies is expected to be 4.8% lower in 2020, including decreases of 5.9% in oil GDP and 3.9% in non-oil GDP. In addition, essential containment measures have significantly slowed non-oil economic activity in critical job-rich industries and travel restrictions (retail trade, hospitality, tourism, real estate). At the same time, decreases in global oil prices and oil demand GCC fiscal and external balances were noted as being in deficits of 8.8% and 0.4% of GDP, respectively, adding to economic challenges. In addition, financial system risks are highlighted by low activity and concern about bank asset soundness.

The recovery in the GCC economy is expected to continue. However, the pace of the recovery varies across the countries. Saudi Arabia's recovery was accelerated after the COVID-19 restrictions were lifted. Several countries in the region experienced a second wave of virus outbreaks. These outbreaks delayed the reopening of various sectors, and they also triggered new control measures. The recovery of non-oil sectors in the Gulf Cooperation Council countries, such as the UAE and Bahrain, has been slower this year. Hard-hit sectors such as retail trade, restaurants, hotels, and real estate are mainly seen in the GCC countries. These account for around 38%

of the non-oil gross domestic product in Bahrain, Qatar, and the UAE compared with 26% in Saudi Arabia. Saudi Arabia's non-oil GDP is expected to expand by 4.7% in 2021, while Bahrain, Kuwait, and the United Arab Emirates are expected to grow by roughly 3%. Oman's non-oil growth is expected to be 112%, whereas Qatar's is expected to be 2% (Lundback & AlHassan, 2021).

The financial sectors of the Gulf Cooperation Council have been resilient throughout the crisis, but new vulnerabilities may arise. Borrowers have been put under a lot of stress as a result of the crisis, but banking institutions across the area are well-capitalized, and documented asset quality and profitability declines have been low, though this varies across countries. Despite the fact that economic recovery is gaining traction, fiscal and financial support measures have likely obscured rising vulnerabilities, such as borrowers' creditworthiness (households, SMEs, corporations). Furthermore, the COVID-19 crisis and oil price shocks have strengthened the relationships between public, financial, and real-estate accounts, indicating possible sources of vulnerability and negative feedback loops, such as poor asset quality (International Monetary Fund, 2021).

Despite the difficulties experienced by banks and borrowers, credit has generally held up during the crisis. In the UAE, credit to the private retail sector is expected to improve this year, while corporate lending continues to decline. In other countries, such as Saudi Arabia, the private sector has remained positive. This credit supply has been supported to a large extent by government support measures, and it may be threatened if the inevitable unwinding is not precisely timed and handled. Inflationary pressures have been restrained, but they may begin to rise if global inflation rises. Inflation in the GCC is predicted to be below 3% on average this year (varying from 3.2% in Kuwait to 1.0% in Bahrain) and reduce to 2–212% in 2022.

Nevertheless, more structural reforms are required to generate higher productivity growth, diversification, and inclusive medium-term potential growth, including:

Increasing resource reallocation efficiency within and between sectors, especially from non-viable to viable businesses, through strengthening and implementing bankruptcy frameworks. In addition, reducing the labor market and financial market distortions that favor the public sector would be especially crucial for GCC countries.

Digitalization is being promoted to prepare for the future of business and ensure macro-financial stability. Countries, sectors, and businesses engaged in digital technology before and during the COVID-19 crisis will gain from the pandemic-accelerated digital revolution. Fintech innovations, central bank digital currencies, and the widespread shift of activities from brick-and-mortar to online present both possibilities and rivalry. The GCC countries have been pioneers in digital transformation in the MENA area. Regulatory sandboxes, for example, provide infrastructure and regulatory support to fintech in Bahrain and Saudi Arabia. In addition, the UAE Data Law, which was recently passed, would aid the transition to greater digitization by protecting individuals' and organizations' privacy and limiting entities' use of private information for profit. Oman has launched the National Financial System Program, which intends to assist in the development of digital

economy-based national enterprises, accelerate digital transformation in the public sector, and improve the quality of electronic services. Efforts in these directions must continue to reap the benefits of digitalization in terms of productivity and broad economic and financial development.

Furthermore, the GCC economies' flexible exchange rates over time may aid the development of non-oil trading industries. Moving away from the peg, on the other hand, would remove a credible monetary anchor, resulting in low and stable inflation and limited short-term competitiveness gains. Deficit reduction and competitiveness-enhancing structural reforms would promote private-sector-led expansion, guarantee sustainable growth, and sustain the peg, while measures to improve cash flow and predicting frameworks and the depth of the domestic financial sector would assist more active financial policy frameworks in the future.

Literature Review

The microfinance industry has increased in importance and popularity throughout the Arab world. MFIs' services can promote economic growth by facilitating financial inclusion in the market (Zhuang et al., 2009). According to Hermes et al., (2009), financial markets and the banking sector influence MFI efficiency; innovative financial markets supported by the banking sector may contribute to MFI efficiency as much as their insufficiency.

Numerous studies have revealed that microfinance has a significant impact on economic growth. For example, Adonsou & Sylwester (2015) evaluated the macroeconomic impact of microfinance using a sample of 71 developing countries from 2002 to 2011. They found that Microcredit has a positive impact on economic growth. However, they discovered no strong evidence of positive effects from microfinance loans in the areas of investment and education. Their findings imply that microfinance promotes development in developing nations. Though, because of the small economic impact of microfinance, the development process will be slow.

Maksudova (2010) investigated Granger-causality tests on 1433 MFIs in 102 countries. The findings of this study suggest various microfinance capital transfer pathways for medium and low-income nations, implying that the degree of MFIs' influence is dependent on a country's underlying level of economic growth.

Donou-adonsou and Sylwester (2017) conducted a comparison of the roles of MFIs and commercial banks in developing nations' economic growth. The study, which included 85 developing nations from 2002 to 2013, revealed that, while the banking sector in developing countries played an important role in investment, their influence on economic growth remained limited.

Alternatively, MFIs contributed to economic growth without playing a significant role in investment. According to Khalaf & Saqfalhait (2019), risky microcredit and microloans may promote the growth of financial intermediaries and financial markets. Therefore, the study concludes that financial intermediaries contribute to

financial expansion, financial inclusion, and technology, which contribute to economic growth.

Bin Amin and Jalal Uddin, (2018) examine the long-run relationship between Grameen Bank Microcredit financing and customers' deposit and economic growth. To examine this relationship, Granger's causality and cointegration test have been applied using annual time-series data. They outline that both the lending and depositing aspects of Grameen Bank positively affect economic growth in the long run.

Mia (2016) examines some of Bangladesh's fundamental characteristics, including socio-economic and macroeconomic data, as well as some essential components of the microfinance sector. Bangladesh has made significant societal and economic growth in the previous several decades. Even though the regulatory environment is inadequate and most MFIs are located in wealthy regions, the study showed that microfinance had considerably contributed to such socio-economic growth.

Raihan et al. (2017) examine the impact of microfinance on Bangladesh's GDP. Their estimates about how the labor market works estimate that microfinance has added roughly 8.9%–11.9% to GDP. Furthermore, the findings indicated that microloan contribution to rural GDP is considerably more significant. Nwude and Anyalechi (2018) did another research on microfinance in Nigeria over a year (2000–2015). This research aims to find out how microfinance activities in Nigeria affect rural economic growth and savings. Findings conclude that microfinance banking in Nigeria has not increased agricultural productivity, but it has helped increase rural savings habits.

Some studies suggest that the macroeconomic environment in which MFIs operate, the degree of a country's financial growth, and the amount of economic formalization and industrialization are all critical factors in determining MFI performance (Assefa et al., 2013; Vanroose & D'Espallier, 2009). Microfinance has an impact on economic growth both directly and indirectly. The direct impact of MFIs on economic growth may be estimated by analyzing the decrease in poor people and the rise in value produced by the disadvantaged and poor's entrepreneurial activities (Maksudova, 2010). As a result, Maksudova argues that microfinance's contribution to economic growth could be classified as a corporate activity. MFIs could also support economic growth indirectly via raising liquidity through financial inclusion and the expansion of retail banking systems.

Research Methodology

Data

The data in this paper is obtained from the World Bank database from 1990 to 2020 and the independent and dependent variables are described in Table 1.

Table 1 Description of model variables

	Dependent variable	
Y	Gross Domestic Product (Constant 2015 US$)	GDP 2015
	Independent variables	
X1	Domestic credit to the private sector by banks (% of GDP)	DCBPS
X2	Market capitalization of listed domestic companies (current US$)	MC$
X3	Foreign direct investment, net inflows (% of GDP)	FDIGDP
X4	Real effective exchange rate index (2010 = 100)	REALEXCH
X5	Inflation, GDP deflator (annual %)	INFGDP

Source of data (World Bank database)

Table 2 Descriptive statistics of variables in panel regression model

	GDP 2015	DCBPS	Mc$	FDIGDP	REALEXCH	INFGDP
Mean	1.6711	47.23770	1.4311	2.320093	114.1515	3.554095
Median	9.7810	42.06263	2.7010	1.133492	113.8764	3.770840
Maximum	6.7911	138.8578	2.4312	33.56602	136.2289	33.75110
Minimum	9.0109	14.82210	1.6109	−5.288191	93.13468	−25.95842
Std. dev	1.7411	21.20887	3.4711	3.802124	12.03887	10.9028
Skewness	1.362188	1.129542	5.631857	3.910767	−0.017751	−0.206554
Kurtosis	3.983270	4.689972	36.97595	28.34615	1.711059	3.321930

Model and Methodology

In this research, Bahrain, Saudi Arabia, Kuwait, Oman, Qatar, and United Arab Emirates are considered sample countries, and the data are collected based on economic, banking, and financial information of these selected countries from 1990 to 2020. All data are collected from the World Bank database. This study examines the impact of microfinance, market capitalization, foreign direct investment, real exchange rate, and inflation on the economic growth of sample countries. A panel data analysis is used to run the regression model via pooled OLS and annual data is applied. The countries that were selected are not active enough in microfinance programs (Abdulrahman, 2016) (Table 2).

$$GDP_{it} = \beta_0 + \beta_{1DCBPS} + \beta_{2MC\$} + \beta_{3FDIGDP} + \beta_{4REALEXCH} + \beta_{5INFGDP} + e_{it}$$

Empirical Result

Unit Root Test

A panel unit root test is applied in the regression model on the panel data, using the Augmented Dickey- Fuller test to find out the stationarity of the variables (Table 3).

Table 3 The result of the unit root test

Variables	Methods	Statistics	P-Value	Order
GDP	ADF-fisher	24.7748	0.0159	1st difference
DCBPS	ADF-fisher	48.2781	0.0000	1st difference
MC$	ADF-fisher	39.0681	0.0000	2nd difference
FDIGDP	ADF-fisher	85.8793	0.0000	1st difference
REALEXCH	ADF-fisher	21.0963	0.0003	1st difference
INFGDP	ADF-fisher	126.230	0.0000	1st difference

T t statistics = *p < 0.10, **p < 0.05, ***p < 0.001.

Table 4 Correlation result

Variables	GDP	DCBPS	MC$	FDIGDP	REALEXCH	INFGDP
GDP	1.00000000	–	–	–	–	–
DCBPS	−0.48564190	1.00000000	–	–	–	–
MC$	0.69309814	−0.11475700	1.00000000	–	–	–
FDIGDP	−0.33964140	−0.14653940	−0.24768050	1.00000000	–	–
REALEXCH	−0.51496700	−0.13573560	−0.18914350	0.19020939	1.00000000	–
INFGDP	−0.03666980	−0.43082710	−0.31610000	0.12987590	−0.12089830	1.00000000

Based on the correlation test, it appeared that the correlation between MC$ and GDP is a little bit high, 0.69, as illustrated in Table 4.

Hausman Test shows that the P-value is greater than 5% and thus random effect model is applied as shown in Table 5, and all variables are statistically significant. Even though numerous types of research indicate that microfinance positively affects economic growth, such as (Dirks, 2011; Donou-adonsou & Sylwester, 2017), the results of our study show that microfinance represented by domestic credit to private sector DCBPS has a negative impact on the economic growth. The findings illustrate that market capitalization has a positive impact on economic growth in line with (Jalloh, 2015), unlike the rest of the variables that show a negative impact on economic growth in line with (Dirks, 2011) and (Maksudova, 2010). Although microfinance institutions might gradually increase consumption over time, some investigations are less optimistic about microfinance institutions' advantages. (Chowdhury, 2009) claims that access to financial resources via microfinance institutions might facilitate consumption; however, this will result in more debt. Numerous elements may be behind the findings that microfinance has no association with economic growth. Consider the period of this research from 1990 to 2020, a financial and political crisis era, such as the global financial crisis between 2008 and 2010 and the political unrest in Arab countries. Furthermore, (Abdulrahman, 2016) states that Arab countries have a lower level of microfinance activities; the quoted world bank report states that millions of small businesses and micro-projects in the Arab region have no access to financial services or financial resources.

Indeed, microfinance institutions in the Arab region did not succeed enough in providing microloan services to add economic and social value. For instance, a

Table 5 Panel regression model, the result of microfinance impact on economic growth

	Pool OLS	Random effect	Random effect	Fixed effect
DCBPS	- 1.37*** (− 9.238)	- 1.37*** (− 6.494)	−1.12*** (−7.080)	- 9.44*** (−9.801)
MC$	0.226*** (6.080)	0.2266*** (4.274)	0.278*** (6.584)	–
FDIGDP	- 8.18*** (−3.507)	−8.18** (−2.465)	- 8.18** (−2.750)	−1.19*** (−5.298)
REALEXCH	- 1.00*** (− 8.359)	−1.00*** (−5.876)	−8.87*** (−6.116)	−1.07*** (−8.901)
INFGDP	−5.08 *** (−3.026)	−5.08** (− 2.127)	–	–
Adjusted R-squared	0.913008	0.913008	0.883438	0.514554
F- statistic	59.7737	59.77370	54.05374	19.72602
Prob (F- statistic)	0.00000	0.00000	0.000000	0.000000
Hausman test Chi-Sq statistic		1.776716	4.099267	100.642101
Chi-Sq d.f		5	4	3
Probability		0.8791	0.3927	0.0000

T t statistics = *p < 0.10, **p < 0.05, ***p < 0.001

survey launched in 2008 in Egypt discovered that several borrowers left microfinance institutions due to the insufficient loans offered by MFIs. They claimed that small loans do not meet their projects' need to be improved. Moreover, the study found that many borrowers could not afford high-interest rates to honor their small loans (Khalaf & Saqfalhait, 2019).

The majority of poor people suffer from a lack of financial and management awareness to understand and run their small projects efficiently, and most of them are struggling to rescue their small businesses and survive. Mosley and Hulme (1996) claim that loans are not only one factor that adds an economic value; however, other complementary elements are essential in increasing credit productivity. Therefore, besides lending microloans, MFIs should provide other products such as training and consultant, technical services, and business skills, and motivate entrepreneurs to improve borrowers' financial awareness to create worthy projects and be survived.

In addition, microfinance may not achieve economic growth in countries with poor regulations and policies and weak institutions (Bae,, & Goyal., 2009). Moreover, several borrowers might utilize microfinance loans for consumption aims, which, undoubtedly, would not generate proceeds. (Karnani, 2007) says that "*Most people do not have the skills, vision, creativity, and persistence to be entrepreneurial. Even in developed countries with high levels of education and access to financial services, about 90% of the labor force is employees, not entrepreneurs*." Therefore, MFIs should be selective and careful about whom they give loans to and pay attention to the small projects that already exist in the markets rather than lending to poor people without entrepreneurial skills, experience, and assets (Easterly, 2007). Saqfalhait, (2011) highlights the essential existence of regulations and

policies for MFIs by policy and decision-makers to reach the final goal of extending access to financial resources to satisfy poverty alleviation and economic growth.

Another reason for the negative impact of microfinance on economic growth might be the high-interest rate that MFIs demand in Gulf countries. Lending small loans with high-interest rates might be unaffordable for poor people and startup businesses. A higher interest rate would be a good way for MFIs to increase profits and eliminate their reliance on subsidies and donations. Indeed, many MFIs in the Arab region seek pure profits instead of looking to the social impact besides proceeds. As a result, it is unaffordable for poor people to borrow with high-interest rates from MFIs and launch a productive small enterprise that accelerates economic growth.

Regarding the economic factors, foreign direct investment negatively impacts economic growth in gulf countries in line with (Elheddad, 2016), and (Asiedu, 2013) found a negative correlation between FDI and economic growth due to the surplus in natural resources in GCC countries. Indeed, these countries depend on rent-seeking activities that are more prone to oil price volatilities which might negatively affect these economies (Asiedu, 2013); encourage governments and policymakers to think about other ways to allocate the FDI to other sectors such as tourism and financial sectors. This diversification could improve the competition and accelerate economic growth rather than depending on oil resources. Moreover, GCC countries are lagging in technology transfer competitiveness with FDI. Bokpin et al., (2015) conclude that labor force and trade openness are among the main elements of attracting Multinational Corporations, while corruption and political instability discourage foreign investors from investing in GCC countries. Increasing financial market competitiveness while reducing market distortions Direct interventions, such as imposing interest rate restrictions on banks, should be avoided because they have proven counterproductive and reduced SME lending (Ferrari and others, 2018).

Conclusion

This paper adds to the existing literature by investigating the impact of microfinance and its role in fostering economic growth in the Gulf region. It also gives information to academic researchers who desire to investigate the microfinance industry, particularly in the Gulf region.

The study investigates the impact of microfinance on economic growth in the GCC using annual data from the World Bank database between 1990 and 2020. A panel data analysis is used to run the regression model via pooled OLS. Results reveal that microfinance is significantly and negatively associated with economic growth, while market capitalization positively impacts the growth. Therefore, financial services provided by the Stock Market may promote economic growth rather than domestic credit provided by the banking sector. In another way, microfinance activities do not involve increasing access to capital like financial market. This might be due to various circumstances, such as political issues, sectoral drivers,

lending rates, interest rates, the regulatory environment, and government intervention. Finally, the chapter suggests that more efforts should be undertaken in financial inclusion, regulatory framework to use microfinance products, and expanding financial services to reach those disadvantaged and poor's entrepreneurial.

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Impact of Nonresident Bank Loans on Economic Activity

İlkay Şendeniz-Yüncü

Abstract This study investigates the role of nonresident bank loans in economic activity. Analyses are conducted with GMM dynamic panel data techniques. The results show that nonresident bank loans have a statistically significant negative effect on economic activity. This finding is robust when controlling for banking sector development and stock market development indicators. The findings also show that while the stock market development indicator has a statistically significant positive effect on real per capita GDP, the banking sector development indicator has a statistically significant negative effect on economic activity, which may be explained by high amounts of debt and nonperforming loans in the sample countries. Results further show that inflation has a statistically significant negative effect on economic activity in all models.

Keywords Nonresident bank loans · banking sector · economic activity

Introduction

Developed financial systems influence economic growth with their functions of improving the information on firms and economic conditions, providing capital to investors and minimizing their risks. Financial intermediaries that produce better information on firms will fund more promising firms and encourage a more efficient allocation of capital. Since financial intermediaries provide profitable investments, they increase additional savings.

Beginning with the works of Bagehot (1873) and Schumpeter (1911, 1934), which stress the critical role of the banking system in economic growth, there have been numerous studies investigating the relationship between finance and economic growth. Bencivenga and Smith (1991) develop an endogenous growth

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model that shows the shift of savings toward capital by the financial intermediaries to promote growth. Their analysis is based on the model of Diamond and Dybvig (1983) which stresses the important role of financial markets as a provider of liquidity to investors. In their model, Bencivenga and Smith (1991) show that banks reduce the amount of savings held in the form of unproductive liquid assets, prevent misallocations of capital due to liquid needs, eliminate the liquidity risk, increase investment in the high-return illiquid assets, therefore, affect resource allocations and real rates of growth. Levine (1997) argues that costs of information gathering and transactions are the incentives for the emergence of financial markets and institutions. Financial systems may affect economic growth by providing other functions such as facilitating the trading, hedging, diversifying, and pooling of risk. Levine (2005) discusses that financial markets and institutions may arise to mitigate the effects of information and transaction costs in the existence of different legal, regulatory, and tax systems. Banks improve the acquisition of information about firms and alter the allocation of credit. Similarly, financial contracts that make investors more confident will influence the allocation of their savings. All those functions affect growth by influencing the rate of capital formation. Project holders use outside funding as a source for investments and banks are the cheapest and fastest mobilization of savings for these project holders. The empirical works of Goldsmith (1969), being one of the leaders of the view that financial intermediation contributes to economic activity, have the assumption that there is a positive correlation between the sizes of financial systems and the supply and quality of financial services. In their cross-country study, King and Levine (1993) built on Goldsmith's work and show that the financial system can promote economic growth. Beck et al. (2000), Levine et al. (2000), Jeong et al. (2003), Berger et al. (2004), Şendeniz-Yüncü et al. (2008), and Cheng and Degryse (2010) are among the other researchers who examine the relationship between banking sector development and economic growth. Atje and Jovanovic (1993), Demirgüç-Kunt and Levine (1996a, b), Harris (1997), Levine and Zervos (1998), Rousseau and Wachtel (1998), and Arestis et al. (2001) are some examples for the studies that examine the relationship between stock market development and economic growth. Merton (1995), and Merton and Bodie (1995) argue that markets and banks complement each other in the context of the finance-growth relationship. Beck and Levine (2004) investigate the impact of both stock markets and banks on economic growth and applied recent Generalized Method of Moments (GMM) techniques developed for dynamic panels that reduce the statistical shortcomings of existing studies. They control for simultaneity bias, omitted variable bias, and the inclusion of lagged dependent variables in growth regressions. They find that stock markets and banks positively influence growth. Şendeniz-Yüncü et al. (2018) analyze the relationship between stock index futures market development and economic growth for 32 developed and developing countries.

Besides financial development, international financial integration is another major factor influencing the economic growth of countries. Edison et al. (2002) define international financial integration as the degree to which an economy does not restrict cross-border transactions and discuss the conflicting predictions about the growth effects of international financial integration. On one hand, there are theories suggesting that financial integration facilitates risk-sharing and thereby enhances production specialization, capital allocation, and economic growth (Acemoglu & Zilibotti, 1997; Obstfeld, 1994). Baele et al. (2004) state that financial integration and development of financial markets are likely to contribute to economic growth by removing frictions and barriers to exchange and by allocating capital more efficiently. In the standard neoclassical growth model, financial integration eases the flow of capital to capital-scarce countries, with positive output effects. Lee et al. (2017) define financial integration as high capital mobility as well as the removal of barriers with regard to international investment, such as transaction costs, information costs, and cultural bias, which enhances international risk-sharing through a diminution in consumption volatility and raises financial stability, thus leading to higher economic growth. On the other hand, according to some other theories, financial integration in the presence of pre-existing distortions can retard growth. Boyd and Smith (1992) predict that financial integration will promote growth only in countries with sound institutions and good policies (see also Şendeniz-Yüncü, 2022).

This study investigates the role of nonresident bank loans in economic activity in the existence of banking sector development and stock market development control measures. Analyses are conducted with dynamic panel data techniques that have many advantages over cross-country and time-series approaches. GMM dynamic panel estimators exploit the time-series nature of the relationship between the variables with pooled cross-section and time-series data, allow for the inclusion of lagged dependent variables as regressors, remove any bias created by unobserved country-specific effects and control for the potential endogeneity of all explanatory variables by the usage of instrumental variables. The results show that nonresident bank loans have a statistically significant negative effect on economic activity. This finding is robust when controlling for banking sector development and stock market development indicators. The findings also show that while the stock market development indicator has a statistically significant positive effect on real per capita GDP, the banking sector development indicator has a statistically significant negative effect on economic activity, which may be explained by high amounts of debt and nonperforming loans in the sample countries. The effects of banking sector development and stock market development on economic activity become statistically insignificant when nonresident bank loans are in the analyses. Results further show that inflation has a statistically significant negative effect on economic activity in all models.

The chapter is organized as follows. Section "Data" describes the data. Methodology and results are presented in Section "Methodology and Results", and Section "Conclusion" concludes the paper.

Data

Table 1 presents 23 countries in the dataset that are considered to be among the world's emerging markets by the Morgan Stanley Capital International (MSCI) Emerging Markets Index. Data period is 2000–2020.

As an indicator of economic activity, the logarithm of annual real GDP per capita (RGDPC) is used. Loans from nonresident banks are presented as a percentage of GDP (NRBL). Banking sector development measure (BAN), stock market development measure (STO), inflation (INF), and foreign direct investment (FDI) are included as control variables, which are commonly used in literature. Variable names, descriptions, and data sources are presented in Table 2.

Descriptive statistics are presented in Table 3, and the correlation matrix is presented in Table 4.

Table 1 Countries in the dataset

Brazil	Greece	Malaysia	Saudi Arabia
Chile	Hungary	Mexico	South Africa
China	India	Peru	Thailand
Colombia	Indonesia	Philippines	Turkey
Czech Republic	Korea, Rep.	Poland	United Arab Emirates
Egypt, Arab Rep.	Kuwait	Qatar	

Table 2 Variable names, descriptions, and data sources

Variable	Description	Data source
RGDPC	Log real GDP per capita (constant 2015 USD)	World Bank World Development Indicators
BAN	Banking sector development measure, private credit by deposit money banks to GDP (%)	World Bank Global Financial Development Database
STO	Stock market development measure, total value traded to GDP (%)	World Bank Global Financial Development Database
NRBL	Loans from nonresident banks (amounts outstanding) to GDP (%)	World Bank Global Financial Development Database
INF	Inflation, consumer prices % annual	World Bank World Development Indicators
FDI	Foreign direct investment net inflows, % of GDP	World Bank World Development Indicators

Table 3 Descriptive statistics

	RGDPC	NRBL	BAN	STO	INF	FDI
Mean	9.11	14.06	58.70	36.39	4.33	3.18
Median	9.09	11.41	50.60	17.16	3.38	2.30
Maximum	11.08	96.02	182.43	372.26	54.92	108.42
Minimum	6.63	0.10	11.61	0.70	−4.86	−40.08
Std. Dev.	0.96	13.29	33.33	47.23	5.17	7.42
Obs.	483	475	475	445	475	483

Table 4 Correlation matrix

	LGDPC	NRBL	BAN	STO	INF	FDI
LGDPC	1.00	0.39	0.28	0.11	−0.21	0.04
NRBL	0.39	1.00	0.22	−0.24	−0.19	−0.02
BAN	0.28	0.22	1.00	0.46	−0.33	−0.06
STO	0.11	−0.24	0.46	1.00	−0.05	−0.07
INF	−0.21	−0.19	−0.33	−0.05	1.00	−0.01
FDI	0.04	−0.02	−0.06	−0.07	−0.01	1.00

Methodology and Results

To assess the dynamic relationship between nonresident bank loans and economic activity, the GMM estimators developed for dynamic panel data models by Arellano and Bond (1991) and Holtz-Eakin et al. (1988) are employed. The dynamic panel technique allows the exploitation of the time-series nature of the relationship between the variables with pooled cross-section and time-series data. By using this technique, it is possible to remove any bias created by unobserved country-specific effects, and it is possible to control for the potential endogeneity of all explanatory variables. The regression equation is as follows:

$$y_{i,t} - y_{i,t-1} = (\alpha - 1) y_{i,t-1} + \beta' X_{i,t} + \eta_i + \varepsilon_{i,t} \tag{1}$$

where y is RGDPC, X represents the set of explanatory variables, including nonresident bank loans, η is an unobserved country-specific effect, ε is the error term, and the subscripts i and t represent country and time period, respectively. The regression equation includes control variables such as BAN, STO, INF, and FDI. The above equation can be rewritten as:

$$y_{i,t} = \alpha y_{i,t-1} + \beta' X_{i,t} + \eta_i + \varepsilon_{i,t} \tag{2}$$

Arellano and Bond (1991) propose to difference the above equation in order to eliminate the country-specific effect as follows:

$$y_{i,t} - y_{i,t-1} = \alpha \left(y_{i,t-1} - y_{i,t-2} \right) + \beta' \left(X_{i,t} - X_{i,t-1} \right) + \left(\varepsilon_{i,t} - \varepsilon_{i,t-1} \right) \tag{3}$$

Differencing eliminates the country-specific effect; however, it now introduces a new econometric problem. The new error term in the difference equation ($\varepsilon_{i,t} - \varepsilon_{i,t-1}$) is correlated with the lagged dependent variable ($y_{i,t-1} - y_{i,t-2}$). To solve this endogeneity problem, Arellano and Bond (1991) propose to use the lagged values of the explanatory variables in levels as instruments. By the assumption of no serial correlation in the error term, and weakly exogenous explanatory variables, GMM dynamic panel estimator uses the following moment conditions:

$$E\left[y_{i,t-s} \left(\varepsilon_{i,t} - \varepsilon_{i,t-1} \right) \right] = 0 \text{for} s \geq 2; t = 3, \ldots, T, \tag{4}$$

$$E\left[X_{i,t-s}\left(\varepsilon_{i,t}-\varepsilon_{i,t-1}\right)\right]=0 \text{for} s\geq 2; t=3,\ldots,T, \quad (5)$$

Arellano and Bond (1991) suggest a two-step GMM estimator using the above moment conditions. In the first step, the error terms are assumed to be independent and homoscedastic across countries and over time. In the second step, the residuals from the first step are used to construct a consistent estimate of the variance-covariance matrix. Consistency of the GMM estimator mainly depends on the assumptions that the error terms do not exhibit second-order serial correlation and that the instruments are valid.

Table 5 presents the dynamic panel GMM estimations. Sargan and serial correlation tests are also implemented, which confirm that the above assumptions hold. The results show that nonresident bank loans have a statistically significant negative effect on economic activity. This finding is robust when controlling for banking sector development and stock market development indicators. The findings also show that while the stock market development indicator has a statistically significant positive effect on real per capita GDP, the banking sector development indicator has a statistically significant negative effect on economic activity, which may be explained by high amounts of debt and nonperforming loans in the sample countries. This result is in line with Zhang (2003), who also documents a significant negative relationship between banking development and economic growth in East Asia during the 1960–1999 period. The effects of banking sector development and

Table 5 Dynamic panel GMM estimations

Dependent variable: RGDPC			
Models	(1)	(2)	(3)
LGDPC(−1)	0.951*** (0.013)	0.928*** (0.009)	0.941*** (0.025)
NRBL		−0.138*** (0.026)	−0.187*** (0.052)
BAN	−0.058*** (0.015)		0.012 (0.034)
STO	0.009*** (0.001)		0.002 (0.002)
INF	−0.002*** (0.000)	−0.002*** (0.000)	−0.002*** (0.000)
FDI	0.000 (0.000)	−0.000 (0.000)	−0.000 (0.000)
Number of Observations	399	425	396
J-stat	16.936	16.432	22.314
Instrument rank	26	24	23
Sargan test (p-val)	0.714	0.247	0.173

The estimated coefficient is presented on the first line for each item, with the standard error reported in parentheses on the second line; the corresponding significance level appears adjacent to the estimated coefficient. *** Significant at 1%; ** significant at 5%; * significant at 10%

stock market development on economic activity become statistically insignificant when nonresident bank loans are in the analyses.

Results further show that inflation has a statistically significant negative effect on economic activity in all models. This result is in line with Hung (2003), who developed an endogenous growth model to illustrate the important role played by inflation in determining the role of financial development on economic growth. The theoretical model of Hung (2003) shows a negative correlation between inflation and economic growth for countries with high initial inflation rates and points out that the possible underlying force is financial development. Hung (2003) states that financial development raises inflation and reduces economic growth for countries with relatively high initial inflation rates. In other words, financial development can reduce inflation and promote growth only when initial inflation rates are relatively low.

Conclusion

In this chapter, the role of nonresident bank loans in economic activity is investigated. Analyses are conducted with GMM dynamic panel data techniques that allow for the inclusion of lagged dependent variable as a regressor, remove any bias created by unobserved country-specific effects and control for the potential endogeneity of all explanatory variables by the usage of instrumental variables.

The results show that nonresident bank loans have a statistically significant negative effect on economic activity. This finding is robust when controlling for banking sector development and stock market development indicators. This result is in line with Boyd and Smith (1992), which predict that financial integration will promote growth only in countries with sound institutions and good policies, as well as the theories, which argue that financial integration in the presence of pre-existing distortions can actually retard growth.

The findings also show that while the stock market development indicator has a statistically significant positive effect on real per capita GDP, the banking sector development indicator has a statistically significant negative effect on economic activity, which may be explained by high amounts of debt and nonperforming loans in the sample countries. This result is in line with Zhang (2003), who also documents a significant negative relationship between banking development and economic growth in East Asia during the 1960–1999 period. The effects of banking sector development and stock market development on economic activity become statistically insignificant when nonresident bank loans are in the analyses. Results further show that inflation has a statistically significant negative effect on economic activity in all models.

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Interaction Between the Prices of Crude Oil, Natural Gas, and Gold with Conventional and Sustainability Stock Market Indices

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Abstract Since the release of the Brundtland Report (Brundtland, 1987), environmental issues and sustainable growth have gained increasing attention worldwide. This study analyzes the relationship between crude oil prices, natural gas prices, gold prices, Dow Jones Sustainability World Index (W1SGI), and Dow Jones Industrial Average Index (DJI) using time series econometrics. The monthly data set covers the December 2011–November 2021 period. Empirical results show that the speed of adjustment to the long-run equilibrium is 8.4% for W1SGI and 3.3% for DJI. In the long run, the effect of crude oil prices and gold prices on both stock market indices are negative and positive, respectively; however, natural gas prices have a positive impact just on W1SGI. Besides, crude oil prices have a bidirectional and unidirectional causal relationship with W1SGI and DJI. Our findings could assist investors in formulating their hedging and diversification strategies. In addition, obtained results could be useful for policymakers to design policies in line with the objectives of international environmental agreements.

Keywords Crude oil · Natural gas · Gold · Dow Jones Sustainability World Index · Dow Jones Industrial Average Index

Introduction

Since the Industrial Revolution, energy use has increased rapidly, supporting economic growth as a primary input (Stern, 2011). Fossil fuels have a global share of 84.3% of energy consumption as of 2019, with oil taking the largest share (Ritchie et al., 2020). While fossil fuels are necessary for economic growth, they also

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increase greenhouse gas emissions (Ritchie et al., 2020) and cause climate change (Foley, 2019). Intensifying global environmental problems have made the impact of fossil fuels on the environment one of the main concerns of the international community. In September 2015, United Nations developed 17 integrated sustainable development goals and set environmental, social, and economic targets to be achieved by 2030. With the Paris Agreement in December 2015, the steps that governments should take to reduce greenhouse gas emissions became more solid (UNFCCC, 2022). However, according to the United Nations' 2021 Production Gap Report, fossil fuel production will double in 2030, contradicting the Paris Agreement's target to reduce global warming by 1.5 °C (UNFCCC, 2021). The issue of sustainability is followed with interest by financial markets. This increased interest has led to the creation of stock market indices that include companies with high sustainability performance. The effect of fossil fuel prices on the sustainability indices has emerged as an exciting research topic. In this study, we examine the impact of fossil fuels and gold prices on the sustainability and conventional stock market indices.

The oil price affects many macroeconomic fundamentals. Oil price impacts inflation directly through the demand-side or indirectly through supply-side factors. Oil is an essential consumer good, hence an increase in its price gives rise to inflation. On the other hand, since oil is the primary input for many industries, higher oil prices make the production of goods more expensive and boost inflation. Oil price is also critical for the production level of many sectors and the GDP growth. Higher oil prices cause a reduction in industrial production, which ultimately leads to lower GDP growth, higher unemployment, and decreased real wages (Dogrul & Soytas, 2010).

Asset pricing theory proposes an explanation for the relationship between oil and stock prices (Youssef & Mokni, 2019). The theory suggests that the discounted sum of expected cash flow reflects the asset value; hence any variable which affects this calculation also affects asset price (Arouri, 2011; Lee & Chiou, 2011). If inflation rises due to oil price hikes, the central bank uses interest rates to fight against inflation. However, an increase in interest rates reduces the discounted expected cash flows; thus, oil prices may indirectly affect the stock prices. In addition, oil prices also affect stock prices directly by changing the expectations about future cash flows through production costs and firms' profitability (Salisu & Isah, 2017; Alamgir & Amin, 2021). Kilian and Park (2009) claimed that oil prices affect asset prices at one month lag, providing evidence favoring the asset pricing theory. Nandha and Faff (2008) explored the relationship between oil prices and 35 sectors' equity returns and found a negative relationship for most sectors. Their findings imply that the differences between the structures of the firms should be considered when examining the impact of energy prices on firms' stock prices. On the contrary, Kocaarslan and Soytas (2019) argued that higher oil prices might raise clean energy stock prices due to substitution behavior.

This study also uses natural gas prices as an independent variable besides oil. First, natural gas is one of the leading energy sources, providing 23.3% of the total

energy supply worldwide (International Energy Agency, 2021). Its demand is expected to grow by 31% by 2050 (Gordon & Weber, 2021). Second, natural gas prices, like crude oil prices, may significantly affect the stock market due to their economic importance. This effect might be direct by impacting the firm's production costs and profit margins or indirect by influencing the activities in the real economy (Acaravci et al., 2012). Third, natural gas emits less carbon dioxide than oil (U.S. Energy Information Administration, 2022), making it an essential energy source for achieving sustainability goals (Aksyutin et al., 2020). For this reason, it can be expected that the effects of oil and natural gas prices on the stock prices of companies included in the sustainability index will be different.

Gold is a scarce indestructible physical commodity that needs to be extracted from underground. It produces less greenhouse gas emissions per dollar than other precious metals during its mining process. Due to its ability to store its high value for a long time, it has a carbon footprint per dollar and improves the portfolio's sustainability in the long run (Baur & Oll, 2019; Mahmood, 2020). For investors, gold is a critical asset for portfolio management and is highly associated with the stock market for the following reasons. First, during financial distress, it gives a sense of security to investors and serves as a safe-haven asset (Baur & Lucey, 2010; Chkili, 2016). Second, investors use gold to hedge against stocks to reduce systematic risks like unexpected inflation (Baur & Lucey, 2010). Third, it is used for diversification to improve portfolio performance (Conover et al., 2009). The reasons mentioned above highlight the importance of gold for both sustainability and conventional stock indexes; hence, it is part of this study.

It is believed that companies that give importance to sustainability and fulfill their social responsibilities will benefit financially in the long run. Sassen et al. (2016) indicated when a firm is involved in socially responsible projects, systematic, idiosyncratic, and total risk will go down. This belief has led to the creation of sustainability indices to track the performance of companies that are committed to sustainability (Lopez et al., 2007; Brooks & Oikonomou, 2018). In this study, we use two different indices to examine whether the traditional stock market and sustainability indices respond differently to the independent variables in our model. We chose W1SGI among numerous other sustainability indexes because it is the oldest global index introduced in 1999 (Naqvi & Jus, 2019). It includes the top 10% of the 2500 largest companies in the S&P Global BMI with the highest scores by ESG factors. It tracks the financial success of companies committed to investing in sustainable projects (S&P Dow Jones Indices, 2022). The second stock market index, DJIA, was chosen for this analysis as it is the oldest and most well-known index in the financial sector (Biktimirov & Xu, 2019). Comparing the results obtained using these two indices will provide valuable findings on the impact of sustainability practices on investor behavior (Giannarakis, et al., 2017a).

The rest of the chapter is structured as follows: Next section will review the literature. Section 3 will explain the properties of the data used in this study and the methodology conducted. Section 4 will provide empirical findings and discussion. Section 5 concludes.

Literature Review

In the existing literature, the impact of crude oil prices on conventional stock market indices has been researched extensively, and the results mostly suggest a negative relationship. Oil is an essential input for production; hence, an increase in its price lowers the firms' profit and impacts the stock prices negatively (Sariannidis et al., 2010). Besides, the crude oil price affects the macroeconomic fundamentals such as inflation and exchange rate, which impact the firm's operational cost and profits and eventually stock prices

(Arouri & Nguyen, 2010; Katircioglu et al., 2015; Delgado et al., 2018). In contrast, Narayan and Narayan (2010) suggest a positive relationship between oil prices and Vietnam's stock market in the long run. Kilian and Park (2009) also stated that the increase in oil prices positively impacts the stock prices in the short run due to unexpected economic expansion. Arouri (2011) investigated this relationship at the sectoral level and indicated that stock prices of different sectors reacted differently to the oil price changes in the short run. Another stream of research found that the stock markets of oil-exporting countries are more sensitive to changes in oil prices than those of oil-importing countries. (Wang et al., 2013; Youssef & Mokni, 2019).

Although natural gas is another basic input for an economy, research on the effect of natural gas prices on the stock market is more limited than that of oil prices. This relatively limited literature provides varying results. Kumar et al. (2019) couldn't find any cointegration relationship between crude oil, natural gas, and stock prices for India. Similarly, Kandir et al. (2013) couldn't find any evidence for a long-run relationship between natural gas prices and stock prices in the case of Turkey. Weak information transmission from energy prices to stock prices is cited as a potential reason for the lack of cointegration between the stock market and the energy market. Another explanation put forward in this regard is that the increase in energy prices does not affect the company's profit since energy costs are fully reflected in sales prices. In contrast, Boyer and Filion (2007) provide evidence for the positive impact of natural gas prices on Canadian energy stock prices. Acaravci et al. (2012) analyzed 15 European countries and confirmed a long-run relationship between natural gas prices and stock prices through the indirect channel of industrial production growth for only five of the EU countries.

The extensive literature on the relationship between the gold price and stock markets is far from consensus. Using cointegration and Vector Error Correction Model (VECM), Bilal et al. (2013) found a long-run relationship between gold prices and the Bombay Stock Exchange (BSE). However, they couldn't find any long-run relationship between gold prices and Karachi Stock Exchange (KSE). Faisal et al. (2018) explored the relationship between Pakistan Stock Exchange, crude oil prices, and gold prices and stated the negative effect of gold prices on the stock market. Raza et al. (2016) suggested a positive impact of gold prices on China, India, Brazil, Russia, and South Africa's stock markets but a negative impact on the stock markets of Mexico, Malaysia, Thailand, Chile, and Indonesia. Additionally, some studies analyzed the Granger causality between gold prices and stock markets. For example, Bhunia and Das (2012) reported bidirectional Granger causality

between gold prices and the National Stock Exchange of India. In contrast, Bilal et al. (2013) suggested a lack of Granger causality between gold prices and BSE and KSE.

A few researchers have investigated the impact of oil, natural gas, and gold prices on clean energy stock prices. Kocaarslan and Soytas (2019) supported the view that oil prices affect clean energy stock prices negatively and asymmetrically in the long run. However, in the short run, this effect is positive and symmetrical due to the speculative behavior of investors. On the other hand, Bibi et al. (2021) showed that oil and gold prices lead to an increase in clean energy stock prices, while the effect of natural gas prices is negative both in the short and long term.

The existing literature on the impact of crude oil, natural gas, and gold prices on sustainability indices is very limited and gives conflicting results. Sariannidis et al. (2010) examined the effect of crude oil prices on the Dow Jones Sustainability Index US (DJSI

US) and Dow Jones Wilshire 5000 Composite Index (DJW 5000). The empirical findings from the GARCH model indicate that crude oil returns negatively affect both indices, and DJSI US reacts to crude oil returns with a month's delay. Giannarakis et al. (2016), identifying gold prices as a proxy for uncertainty, elucidated it negatively impacts DJSI US. However, Giannarakis, et al. (2017b) indicated gold and oil prices positively impact Dow Jones Sustainability World Index (DJSIW). Based on modern portfolio management, they stated that investors see gold as a hedging tool, and therefore, stock market investors feel more secure when they include gold in their portfolios. This approach explains the positive relationship between gold and stock markets. In addition, they cited that the increase in oil prices is perceived as an economic expansion by investors, which leads them to invest in sustainability stocks. Liu et al. (2021) argued that there is a return spillover from crude oil and gold to ESG indices in the USA and Europe.

Although some studies have similarities with our research to some extent, our study has differences. Sariannidis et al. (2010) researched the impact of macroeconomic variables, including oil prices, on sustainability and conventional stock indices; however, their analysis does not include natural gas and gold prices. Giannarakis et al. (Giannarakis, Lemonakis, et al., 2017b) investigated gold and crude oil prices as the potential drivers of DJSIW. But, they neglected natural gas prices and didn't use any proxy for a conventional stock index for comparison purposes. Kumar et al. (2021) studied how gold, natural gas, and crude oil impact the stock market. They focused on the Indian stock market and didn't use any sustainability index for comparison. Bibi et al. (2021) examined the impact of oil, natural gas, and gold prices on clean energy stock prices; hence our study differs from theirs in terms of the main research question. Liu et al. (2021) studied how gold, crude oil, and the stock market affect the return and volatility spillover of the ESG Index in the USA and Europe. In contrast to our study, they treated the stock market as one of the independent variables and did not include natural gas in their study. However, no study analyzes the interaction of crude oil, natural gas, and gold prices with the W1SGI and the DJIA to our best knowledge. Therefore, conducting this study will fill the gap in the existing literature.

Data and Model

This research is based on secondary data obtained from various data sources. In this section, the properties of the data and the correlation between the variables will be examined, and then it will be followed by the model specification.

Data

We collected crude oil, natural gas, and gold prices data from the World Bank Commodity Market publication (World Bank, 2022). We gathered DJIA data from Yahoo Finance (Yahoo Finance, 2022) and W1SGI from the S&P Dow Jones Indices website (S&P Dow Jones Indices, 2022). W1SGI represents 10% of the 2500 largest companies in S&P Global BMI based on economic, environmental, and social factors (S&P Dow Jones Indices, 2022). DJIA represents one of the most widely known conventional stock market indices globally. In this study, Brent crude oil – light crude oil extracted in the North Sea – prices are used because it is more efficient than alternatives (Brent, 2022; Okoroafor & Leirvik, 2022). Brent crude oil prices are measured in terms of $/bbl (dollar per barrel). Natural gas and gold prices are the spot prices. Natural gas prices are measured in terms of $/MMBtu (dollar per metric million British thermal units), and gold prices are measured in terms of $/troy oz. For each variable, monthly data from December 2011 to November 2021 was used.

Descriptive Statistics

A graphical view of the logarithmically transformed variables is displayed in Fig. 1. Both LW1SGI and LDJIA show an upward trend over the study period, with changing mean values implying nonstationarity. However, any trend is not observed in crude oil prices (LCO) and natural gas prices (LNG). LCO has a dip in 2015, coinciding with an excess oil supply, strengthening the dollar, and the weak world economy (Tarver, 2021). Another dip is observed in 2020 due to the COVID-9 pandemic and the resulting global economic problems, especially the demand constraint. Gold prices (LGLD) show a downward trend until 2016 but follow an upward trend for the remainder of the period. This can be attributed to low-interest rates and investors' pessimistic expectations regarding economic activities (Barsky et al., 2021).

We display the descriptive statistics for the logarithmic form of the variables in Table 1. For each variable, a total of 120 observations have been used. LCO has the

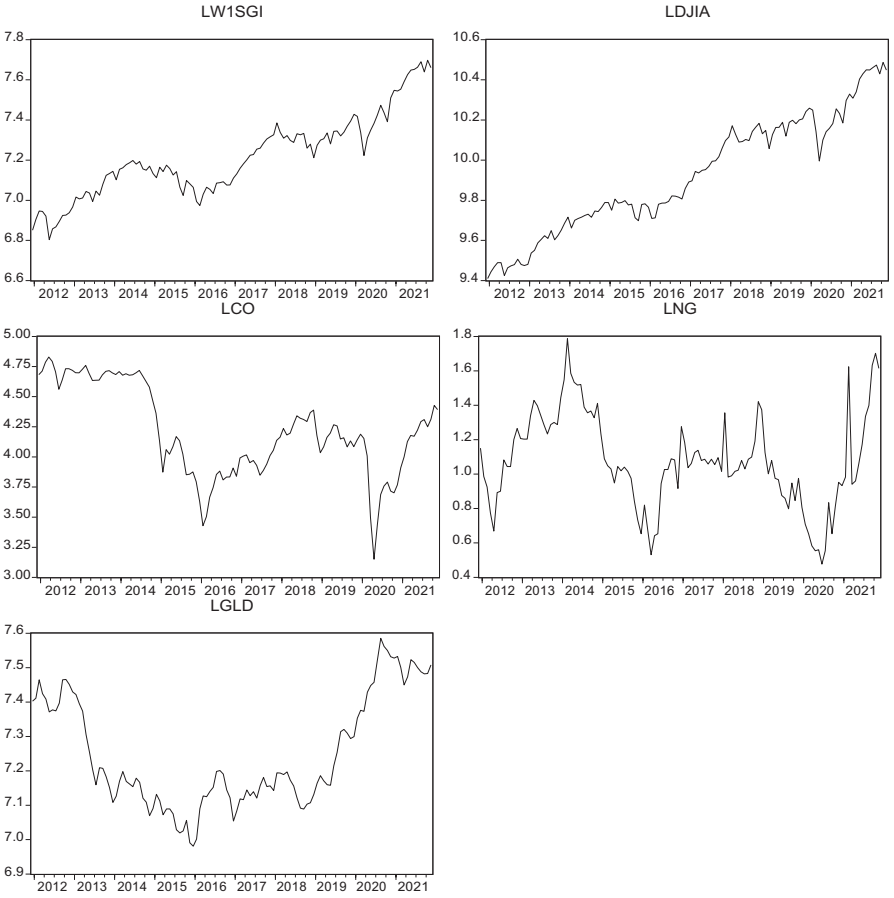

Fig. 1 Time series plots of the logarithmic form of variables

highest standard deviation, which signals the highest volatility and risk compared to other variables. LGLD has the lowest standard deviation, consistent with the idea that gold is considered a hedging instrument. All of the variables are normally distributed, except LGLD.

Table 2 shows the correlation coefficients among variables. LCO has a moderate negative correlation with the W1SGI and DJIA. LNG has a positive weak correlation with W1SGI and negative weak correlation with DJIA. On the other hand, LGLD has a moderate positive correlation with both indices. The highest correlation coefficient between the independent variables belongs to the LCO-LNG pair with 61%. The obtained coefficients imply no reason to suspect any multicollinearity problem in the estimated models.

Table 1 Descriptive statistics

	LW1SGI	LDJIA	LCO	LNG	LGLD
Mean	7.214	9.923	4.211	1.076	7.248
Std. Dev.	0.204	0.290	0.373	0.273	0.161
Maximum	7.697	10.486	4.828	1.787	7.585
Minimum	6.803	9.411	3.150	0.476	6.981
Skewness	0.447	0.113	−0.135	0.151	0.503
Kurtosis	2.774	1.978	2.336	2.835	1.923
Jarque-Bera	4.246	5.479	2.570	0.589	10.868
p-values	0.120	0.065	0.277	0.745	0.004
Observation	120	120	120	120	120

Table 2 Correlation matrix

	LW1SGI	LDJIA	LCO	LNG
LDJIA	0.960			
LCO	−0.294	−0.444		
LNG	0.059	−0.094	0.611	
LGLD	0.366	0.274	0.140	−0.094

Model

Following the existing literature, we set index prices as endogenous variables and crude oil, natural gas, and gold prices as exogenous variables studies (see Arouri & Nguyen, 2010; Narayan & Narayan, 2010; Filis et al., 2011). Our models are specified as follows:

W1SGI = f(Crude Oil Prices, Natural Gas Prices, Gold Prices) DJIA = f(Crude Oil Prices, Natural Gas Prices, Gold Prices)

We used logarithmic forms of the variables to have a better economic interpretation of the estimated coefficients. So, LW1SGI, LDJIA, LCO, LNG, and LGLD represent the logarithmic form of the Dow Jones Sustainability World Index, Dow Jones Industrial Average Index, crude oil, natural gas, and gold prices, respectively. Two empirical models that will be estimated are:

$$\mathrm{LW1SGI}_t = \beta_0 + \beta_1 \mathrm{LCO}_t + \beta_2 \mathrm{LNG}_t + \beta_3 \mathrm{LGLD}_t + \mathrm{e}_t \quad (1)$$

$$\mathrm{LDJIA}_t = \alpha_0 + \alpha_1 \mathrm{LCO}_t + \alpha_2 \mathrm{LNG}_t + \alpha_3 \mathrm{LGLD}_t + \mathrm{e}_t \quad (2)$$

Where β_0 and α_0 represent the coefficients of the constants, β_1, β_2, β_3, α_1, α_2, and α_3 represent the coefficients of the exogenous variables. All of the empirical results are obtained by running Eviews 10 software.

Methodology and Empirical Findings

We use time series econometrics to analyze the long-run relationship between LCO, LNG, and LGLD with LW1SGI and LDJIA. We will start with the unit root test, followed by the Johansen Cointegration test and VECM. Granger causality test results will also be discussed in this section.

Unit Root

While using time series data, first, stochastic properties of data have to be tested because these properties will guide us in choosing the econometric methods to be followed. We applied Augmented Dickey-Fuller (ADF) (Dickey & Fuller, 1981), Phillips Perron (PP) (Phillips & Perron, 1988) unit root tests, and the Kwiatkowski–Phillips–Schmidt–Shin (KPSS) (Kwiatkowski et al., 1992) stationarity test to examine whether the variables are stationary. Because each test has limitations, we used all three tests for confirmatory purposes.

ADF and PP unit root tests have the same null hypothesis; the variable has a unit root. Failing to reject the null hypothesis means the series is not stationary. In contrast, the null hypothesis of the KPSS test is stationarity. Therefore, failing to reject the null hypothesis means the data is stationary.

Table 3 reports the results of the ADF, PP, and KPSS tests. All three tests imply that the series are nonstationary at level but stationary at the first difference. This means that variables are integrated of order 1; hence we can perform a cointegration test based on the Johansen approach.

Optimal Lag Length

Determining optimal lag length in a Vector Autoregressive (VAR) model is vital for the cointegration test based on the Johansen approach. We used information criterion to determine the optimal lag length.

Table 4 displays the results from LogL, Sequentially Modified Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC), and Hannan-Quinn information criterion (HQ). As per the outcome, LR, FPE, and AIC show lag 3 is appropriate. We based our decision on the majority of the information criteria and used lag 3 as the optimal lag length for the remaining part of the analysis. We also checked the VAR system stability by confirming the characteristic roots lie outside the unit circle; hence the system is stable.

Table 3 Unit Root Test result

Plan A: ADF At llLevel	With Trend & Intercept		With Intercept		Without Trend & Intercept	
Variables	Test Statistics	Prob	Test Statistics	Prob	Test Statistics	Prob
LW1SGI	−2.337	0.411	−0.667	0.850	1.874	0.985
LDJIA	−3.491**	0.045	−0.676	0.848	2.426	0.996
LCO	−1.774	0.711	−2.052	0.265	−0.536	0.483
LNG	−2.620	0.273	−2.717	0.074	0.002	0.681
LGLD	−1.701	0.745	−1.149	0.694	0.196	0.741
Panel B: ADF at first difference						
Variables						
LW1SGI	−11.708*	0.000	−11.727*	0.000	−11.443*	0.000
LDJIA	−11.756*	0.000	−11.804*	0.000	−11.266*	0.000
LCO	−8.294*	0.000	−8.216*	0.000	−8.239*	0.000
LNG	−13.579*	0.000	−13.597*	0.000	−13.633*	0.000
LGLD	−8.227*	0.000	−7.992*	0.000	−8.022*	0.000
Panel C: PP at level						
Variables						
LW1SGI	−2.171	0.501	−0.490	0.888	2.330	0.995
LDJIA	−3.496**	0.044	−0.443	0.897	3.883	1.000
LCO	−1.695	0.748	−1.899	0.332	−0.401	0.538
LNG	−2.509	0.323	−2.616***	0.093	−0.171	0.622
LGLD	−1.419	0.8505	−0.6789	0.8470	0.2486	0.7567
Panel D: PP at first difference						
variables						
LW1SGI	−11.914*	0.000	−11.901*	0.000	−11.523*	0.000
LDJIA	−12.788*	0.000	−12.707*	0.000	−11.319*	0.000
LCO	−7.734*	0.000	−6.895*	0.000	−6.909*	0.000
LNG	−13.713*	0.000	−13.633*	0.000	−13.668*	0.000
LGLD	−7.916*	0.000	−7.885*	0.000	−7.918*	0.000
Panel E: KPSS at level						
Variables						
LW1SGI	0.131***		1.134			
LDJIA	0.063		1.278*			
LCO	0.179**		0.600**			
LNG	0.079		0.213			
LGLD	0.291*		0.388***			
Panel F: KPSS at first difference						
Variables						
LW1SGI	0.079		0.097			
LDJIA	0.061		0.062			
LCO	0.066		0.152			
LNG	0.072		0.120			
LGLD	0.047		0.440***			

Note: *, ** and *** represent for significant level at 1%, 5%, and 10%, respectively

Table 4 VAR lag order selection criteria

Model 1						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	85.511	NA	2.55e-10	−1.527	−1.430	−1.488
1	622.237	1017.886	2.51e-10	−10.754	−10.269*	−10.557
2	650.661	52.281	2.01e-10	−10.976	−10.102	−10.622*
3	668.111	30.848*	1.97e-10*	−11.002*	−9.740	−10.490
4	677.353	15.679	2.23e-10	−11.881	−9.231	−10.212
5	682.381	8.170	2.74e-10	−10.685	−8.646	−9.858
6	687.786	8.398	3.35e-10	−10.496	−8.069	−9.511
7	694.534	10.000	4.02e-10	−10.331	−7.515	−9.189
8	701.619	9.995	4.83e-10	−10.172	−6.968	−8.872
Model 2						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	45.945	NA	5.56e-06	−0.749	−0.652	−0.710
1	615.563	1088.376	2.83e-10	−10.635	−10.150*	−10.438
2	645.120	54.365	2.22e-10	−10.877	−10.003	−10.523*
3	661.390	28.763*	2.22e-10*	−10.882*	−9.620	−10.370
4	670.595	15.614	2.52e-10	−10.761	−9.110	−10.091
5	675.636	8.192	3.09e-10	−10.565	−8.526	−9.738
6	680.339	7.306	3.83e-10	−10.363	−7.936	−9.378
7	693.211	19.077	4.12e-10	−10.307	−7.492	−9.165
8	701.122	11.160	4.87e-10	−10.162	−6.959	−8.863

Johansen Cointegration Test and VECM

When a set of nonstationary variables have a stationary linear combination, it means they are cointegrated. In the presence of cointegration, variables have a long-run relationship and move together (Brooks, 2008). If all the variables in an empirical model are integrated of order 1, I(1), one of the options is to use the Johansen cointegration test to determine if there is a long-run relationship among the variables (Johansen, 1991).

Under Johansen's approach to testing the cointegration relationship, trace test statistics can be used. "*The null hypothesis (H0) under trace test statistic is the number of distinct cointegrating vectors which is less than or equal to "r" against a general alternative*" (Enders, 2014, p.379), where "r" indicates the number of cointegrating relations. If the null hypothesis stating that there is no cointegration cannot be rejected based on trace statistics in favor of the alternative hypothesis, this means that there is no long-term relationship between the variables. In that case, the analysis cannot be continued any further. However, if the null hypothesis of no cointegration, r = 0, can be rejected, it indicates the existence of at least one cointegration vector. Under this circumstance, we should continue the hypothesis testing.

This process is continued by adding an additional vector to the hypothesis at each stage until we cannot reject the null hypothesis (Brooks, 2008).

We utilized the Pantula Principle (Pantula, 1989) to determine the proper model for the cointegration relationship. We prepared Table 5 based on the Pantula Principle. Table 5 confirms we have at least one cointegrating relationship under Model 2. Once we ensure there is a long-run relationship, we can continue with conducting VECM modeling.

Before proceeding further, diagnostics checks on residuals were performed. The serial correlation LM test and residual heteroskedasticity test (levels and squares) results showed no issue of serial autocorrelation and heteroskedasticity.

A negative and significant error correction term (ECT) indicates the endogenous variable converges to long-run equilibrium after there is a shock to the system. Additionally, the coefficient of the ECT, which is also known as the speed of adjustment, shows how fast the long-run equilibrium will be reached (Brooks, 2008). Table 6 shows LW1SGI converges to its long-run equilibrium by 8.4% speed of adjustment by the contribution of LCO, LNG, and LGLD, whereas LDJIA converges to its long-run equilibrium at a much slower rate by 3.3%.

Table 6 provides the short-run VECM coefficients of the estimated models and long-run equations. The long-run effect of LCO on both indices is significant and negative. One percent increase in LCO would decrease LW1SGI and LDJIA by 0.75% and by 1.16% in the long run. These findings are consistent with theoretical expectations and previous empirical studies (Sariannidis et al., 2010). As the oil prices increase, the firms' profits will decrease, eventually reflected in the stock price in both indices. However, it should be mentioned that there are also studies

Table 5 Pantula Table (based on trace test statistic results)

Series: LW1SGI LCO LNG LGLD			
Trace Test			
R	Model 2	Model 3	Model 4
None	56.83(54.08)*	44.75 (47.86)	53.22 (63.88)
At most 1	31.12 (35.19)	20.33 (29.80)	27.52 (42.92)
At most 2	16.57 (20.26)	8.51 (15.49)	13.68 (25.87)
At most 3	4.96 (9.16)	0.01 (3.84)	4.26 (12.52)
Series: LDJIA LCO LNG LGLD			
Trace Test			
R	Model 2	Model 3	Model 4
None	58.94 (54.08)*	40.02 (47.86)	55.51 (63.88)
At most 1	37.22 (35.19)*	20.68 (29.80)	35.13 (42.92)
At most 2	18.78 (20.26)	8.57 (15.49)	18.37 (25.87)
At most 3	8.00 (9.16)	0.24 (3.84)	8.17 (12.52)

Trace test statistics indicate 1 cointegrating eqn(s) at 0.05 level

Table 6 Vector error correction model results

Short run coefficients		
Variables	D(LW1SGI)	D(LDJIA)
ECT	−0.084 (−4.802*)	−0.033 (−4.543*)
D(LW1SGI [−1])	−0.245 (−2.479**)	
D(LW1SGI [−2])	−0.188 (−1.834***)	
D(LDJIA [−1])		−0.234 (−2.301**)
D(LDJIA [−2])		−0.243 (−2.279**)
D(LCO [−1])	0.098 (2.336**)	0.095 (2.197**)
D(LCO [−2])	0.031 (0.805)	0.001 (0.036)
D(LNG [−1])	−0.059 (−2.058**)	−0.023 (−0.904)
D(LNG [−2])	−0.041 (−1.568)	−0.012 (−0.489)
D(LGLD [−1])	0.122 (1.073)	−0.024 (−0.206)
D(LGLD [−2])	−0.031 (−0.273)	−0.170 (−1.468)
Long Run Equations		

$$\underset{(5.043^{*})}{LW1SGI} = \underset{(-4.988^{*})}{-0.747LCO} + \underset{(-5.409^{*})}{1.109LNG} + \underset{(0.707)}{1.463LGLD} - 1.331$$

$$\underset{(2.926^{**})}{LDJIA} = \underset{(-1.656)}{-1.155LCO} + \underset{(-2.753^{**})}{0.974LNG} + \underset{(-0.006)}{1.953LGLD} + 0.031$$

Note: *, ** and *** represent for significant level at 1%, 5%, and 10%, respectively
Values in () are t-statistics.

that contradict this finding (Narayan & Narayan, 2010). Short- run results show a positive effect of LCO, similar to some results of previous research (Kilian & Park, 2009; Bibi et al., 2021; Kocaarslan & Soytas, 2019). Oil price increase stimulated by the economic growth encourages investors to continue to invest in conventional stock in the short run (Kilian & Park, 2009).

LNG has a significant positive impact on LW1SGI in the long run. One percent increase in LNG will increase LW1SGI by 1.11%. As natural gas prices rise, the demand for sustainability stocks also increases. This finding contradicts that of Bibi et al. (2021); however, it is consistent with Boyer and Filion (2007). Similar to Kumar et al. (2019) and Kandir et al. (2013), we couldn't find any evidence for the effect of natural gas prices on LDJIA in the long run. Kandir et al. (2013) justified this finding with market inefficiencies, energy costs to be fully reflected in sales prices, and separation between energy markets and stock markets.

There is no evidence regarding the short-run impact of LGLD on any indices we investigated. However, in the long run, LGLD has a positive impact on both indices. When LGLD goes up by 1%, LW1SGI and LDJIA increase by 1.46% and 1.953%, respectively, indicating gold is a safe asset to hold while investing in stocks. This finding is in harmony with many existing studies in the literature (Bhunia & Mukhuti, 2013; Raza et al., 2016; Giannarakis, et al., 2017b).

Table 7 Granger Causality Test results

Model 1				
	D(LW1SGI)	D(LCO)	D(LNG)	D(LGLD)
D(LW1SGI)	–	5.102***	0.145	0.910
D(LCO)	6.987**	–	6.689**	0.353
D(LNG)	4.872***	2.035	–	0.691
D(LGLD)	1.154	4.746***	0.846	–
ALL	10.405	14.268**	8.688	2.257
Model 2				
	D(LDJIA)	D(LCO)	D(LNG)	D(LGLD)
D(LDJIA)		3.382	0.543	4.837***
D(LCO)	5.107***		7.094**	0.152
D(LNG)	0.878	0.679		0.096
D(LGLD)	2.569	4.829	1.147	
ALL	6.656	10.314	10.876***	5.316

Note: *, ** and *** represent for significant level at 1%, 5%, and 10%, respectively

Granger Causality

We performed Granger causality test to determine whether there is any causal relationship among the variables. The results are given in Table 7. Obtained coefficients show a bidirectional causal relationship between LCO and LW1SGI, and LNG Granger causes LW1SGI. The Granger causality test for LDJIA indicates that LCO Granger causes LDJIA.

Conclusion

There is a belief that the companies who incorporate sustainability in their operations and act socially responsibly will get financial benefits in the long run. The use of fossil fuels is one of the main threats to sustainability. However, only a handful of studies are performed on the interaction of the sustainability index with fossil fuels. This study aims to understand the long-run relationship of crude oil, natural gas, and gold prices with the sustainability and conventional stock market indices for the 2011M12–2021M11 period. Obtained results confirm a long-run relationship among these variables. Besides, our findings indicate that gold and oil prices affect both indices positively and negatively, respectively. While natural gas prices positively impact W1SGI, it has no significant impact on DJIA in the long run.

Our findings could benefit investors in structuring optimal portfolios. The information on the interaction of energy and gold prices with WSGI and DJIA will enhance their investment decisions. For long-term investors who expect natural gas prices to rise and oil prices to fall, investment in the sustainability index could be an optimal choice. Additionally, although gold is considered a safe haven, especially in

times of crisis, it should not be forgotten that it has a positive relationship with sustainability and the conventional index when making portfolio diversification decisions. Our findings also could guide companies in creating their operational and financial plans. Our research reveals that the development of policies that support low carbon emissions, where economic growth is based on alternative clean energy sources, and thus reducing the negative impact of crude oil prices on stock market indices, should be among policymakers' priorities.

Further research could focus on country-level or regional sustainability stock indices to provide more insight regarding this research question.

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Determinants of Financial Performance: Case of Solar Panel Manufacturers in China

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Abstract This research has sought to investigate the effect of firm-specific and macroeconomic indicators on the financial performance of solar panel manufacturers in China. Return on equity (ROE) was used as an indicator of financial performance. The secondary data was retrieved from companies' annual reports. The relationships between ROE and variables affecting it were evaluated with panel data. The sample size included 10 publicly listed manufacturing companies in China for the period from 2010 to 2020. The feasible generalized least square (FGLS) method was applied to reveal which indicators affect companies' financial performance. The findings of this study indicated that management efficiency, dividend payout policy, capital adequacy, GDP growth, political stability, and tax rate have a significant impact on the ROE of companies in the sample. Capital structure, liquidity, and control of corruption affecting variables have an insignificant impact on ROE.

Keywords Financial performance · ROE · Solar panels manufacturers · Regression analysis

Introduction

The generation of energy from renewable energy sources has become a highly discussed topic during the past decades. Many countries have admitted the importance of developing alternative energy sources to diminish the pollution coming from traditional energy sources like fossil fuels. At the same time, the economic development of countries has led to an increase in demand for energy. Therefore, sustainable, and clean sources of energy bring a significant contribution to the matter of coping with issues of environmental pollution, economic growth, and raising standards of living.

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To achieve a sustainable future, a Paris agreement was signed by 190 countries that aimed to cope with climate change. This created a solid ground for further development of renewable energy sources. Developed countries now are aiming at greater inclusion of renewables into the overall supply of energy and are helping developing countries to do so. Particularly, governments around the world are now providing incentives to boost the generation of energy from clean energy sources like solar, wind, etc.

As a result, investments in the renewable energy industry increased tremendously during the last few years. Thus, investors are eager to know whether such investments are financially sustainable.

An important source of clean energy is the one obtained from the sun with the use of photovoltaic (PV) technology. In the scope of global interest in clean energy sources, the industry of solar panel manufacturing has experienced a significant rise in demand. Solar product manufacturers in China are currently the largest players in the global market. China has a superior solar supply chain and impressive manufacturing capacity compared to the rest of the world. The major contributing factor to the success of Chinese manufacturers was significant support from the Chinese government in the form of financial and policy incentives.

The aim of this study is to investigate how internal (firm-specific) and external (macroeconomic) indicators are affecting the financial performance (ROE) of Chinese companies. Next, the agency cost theory regarding the dividend payout ratio will be tested based on the findings of this study.

This study starts with the literature review followed by data and methodology. Results and interpretations will be discussed next, and they will be followed by a conclusion and recommendations.

Literature Review

Return on Equity as a Financial Performance-Dependent Variable

Xu (2014) states that return on equity (ROE) is one of the most important indicators of profitability and can show the portion of profit attributable to the shareholders. Higher ROE demonstrates the higher ability of companies to generate internal cash. Ghelli (2013) indicates that high ROE proves that a company efficiently uses invested money. At the same time, ROE can be compared among the companies and reveal the profitability of a whole industry (Xu, 2013). Traub (2001) explains that ROE can be used in three ways to measure a company's profitability. ROE can be used as an absolute number; it can be compared with other peer companies and an analysis of the ROE's trend can be done.

ROE can be calculated as follows: **Return on Equity = Net income/Total equity**

Christina (2020) uses ROE as a dependent variable in her research on how social responsibility affects companies' financial performance. Kharatyan et al. (2017) investigated factors (ratios and indicators) that affect ROE for companies enclosed in NASDAQ-100. Mirza and Javed (2013), in their research, indicated ROE as a dependent variable for investigating how the financial performance of 60 Pakistani corporate firms was affected by external and internal factors.

Firm-Specific Variables

Capital Structure

Gunawan and Daulay (2016) examined the impact of capital structure on the financial performance of 756 Indonesian companies and concluded that long-term and short-term debts have a significant impact on performance. Specifically, the authors argue that higher long-term debt decreases ROE, while higher short-term debt has a positive effect on ROE. Zhou and Sihombing (2019) in their research aimed to empirically determine how the capital structure is affecting the ROE and ROA of 32 Indonesian companies. The result of their study showed that capital structure plays a significant role in the financial performance of companies. Another study by Hajisaaid (2020) demonstrated that short-term debt to total assets ratio and long-term debt is negatively related to ROE, while total debt is positively related to ROE. The study covered the financial performance of eight Saudi Arabian companies.

Capital Adequacy

Vinasithamby (2015) indicates the firm size as a capacity of production that a company can offer to its customers. Asimakopoulos et al. (2009) studied that companies of greater size take advantage of negotiating the price of inputs and the number of outputs. According to the study of the manufacturing sector by Akbas and Karaduman (2012), the company size has a positive effect on financial performance. Dogan (2013) had the same study results and revealed a positive relationship between profitability and company size indicators like total assets and number of employees.

On the other hand, the study of Becker-Blease et al. (2010) revealed that there is a negative relationship between profitability and company size measured as total assets and sales.

Liquidity

According to the research of Li et al. (2020) that studied the financial performance of 15 non-financial entities in Ghana, liquidity has a significant adverse impact on ROE and at the same time insignificant positive effect when surrogated by the cash flow ratio.

Management Efficiency

The study of Ikapel et al. (2019) examined how financial management efficiency is related to the performance of commercial banks in Kenya. Using ROE as a dependent variable predicted by an independent variable such as financial management, researchers concluded that there is a strong and positive correlation between the performance of the banks and management efficiency. The authors suggest that commercial banks should improve their managerial mechanisms to improve their performance.

Decision Dividend Policy (Dividend Share to Net Income)

Study findings of Kafle (2020) reveal that "there is a significant positive relationship between dividend policy and financial performance." The authors used data for 50 Indian companies listed on the stock exchange with the application of correlation and regression analysis which finally demonstrated the results consistent with bird in hand and agency theories.

The study of 450 Vietnamese firms listed on the stock exchange by Nguyen et al. (2021) provides the conclusion that dividend payment decision negatively affects firms' accounting-based performance (ROE), while improving market expectations of firms at the same time.

Macroeconomic Variables

Control of Corruption

According to the study by Williams and Martinez-Perez (2016), bribes to public officials are positively affecting firms' performance. This conclusion is derived from the evidence that bribe payments are playing the role of regulator of institutional imperfections existing in developing countries. Such imperfections like weak

public administration can be eliminated for firms with the help of payments to corrupt officials.

The effect of corruption on private firms is differently valued in the paper of Nam et al. (2021). While Williams and Martinez-Perez (2016) positively assessed the corruption effects in their study, the case of Vietnamese companies analyzed by Nam et al. (2021) provides evidence of the deterioration effect of corruption on firms. Here corruption exposes firms to a greater possibility of failure.

Political Stability

Yahya et al. (2017) describe in their study that political stability has a significant effect on the profitability of Islamic banks in Yemen. Results of the study suggest that political instability positively impacted the ROE of Islamic banks during the 2010 and 2014 periods of study. At the same time, Hosny (2017) argues that his study of 6000 private firms in eight countries in the Middle East and North Africa shows that political instability has a negative effect on firms' performance.

GDP Growth

Riaz and Mehar (2013) studied macroeconomic indicators that affect the profitability of banks in Pakistan from 2006 to 2010. The regression results indicate that the annual GDP growth rate has a significant impact on ROE. As the economy grows in Pakistan and production goes higher, the improved environment creates greater development opportunities for the banking sector.

At the same time, Liu et al. (2021) in their research demonstrate that external factor in the form of GDP growth rate has no significant impact on the financial performance of companies (ROE). The results of the study suggest that the financial performance of 39 companies in China was not affected by the GDP growth variable.

Tax Rate

According to Pitulice et al. (2016), the tax rate negatively affects companies' performance indicators. A study by Kurawa (2018) finds that there is "an insignificant negative relationship between corporate tax and financial performance using return on assets as a measure." On the contrary, the study findings of Otwani et al. (2017) revealed a positive relationship between corporate income tax and the financial performance of companies in the research sample.

Agency Cost Theory

According to Anazonwu et al. (2018), agency cost is an internal cost that exists between management (agent) and shareholder (principal), because of conflicts of interests. Dividend payments can serve as a mitigating factor to reduce such costs.

Data and Methodology

The Data

The study is based on panel data statistics of 10 solar panel manufacturing companies in China. The analysis covers the period between 2011–2020 for all the variables.

The secondary data for research was collected from companies' annual reports for firm-specific variables and World Bank database macroeconomic variables (Table 1).

Methodology

The purpose of this study is to empirically investigate the impact of firm-specific and macroeconomic factors on the sample of ten solar panel manufacturing companies' ROE. Descriptive research is adopted with the collection of secondary data for further revelation of relationships among the investigated variables.

To empirically investigate the variables, feasible generalized least square (FGLS) was employed.

Table 1 Summary of variables

Symbol	Variables	Proxy
Dependent variable		
ROE	Return on equity	Net income/Equity ratio
Independent variables		
LIQ	Liquidity ratio	Current assets/Current liabilities ratio
MGMT	Management efficiency	Net income/total assets ratio
CAP	Capital structure	Debt/equity ratio
CADEQ	Capital adequacy	Equity to assets
DIV	Decision dividend policy	Dividend payout ratio
COR	Corruption control	World Bank percentile rank
GDP	GDP	GDP growth rate
POL	Political stability	World Bank percentile rank
TAX	Tax rate	Corporate income tax rate

The regression model is as follows:

$$Y = \beta 0 + \beta 1CADEQ + \beta 2LIQ + \beta 3MGMT + \beta 4CAP + \beta 5DIV + \beta 6COR + \beta 7GDP + \beta 8DUM + \beta 9POL + \varepsilon$$

Here Y represents the dependent variable, β represents the coefficients, β0 and ε represent the constant term and error term, respectively.

As the dependent variable of this study is ROE, the regression model for it is shown below:

$$ROE = \beta 0 + \beta 1CADEQ + \beta 2LIQ + \beta 3MGM + \beta 4CAP + \beta 5DIV + \beta 6COR + \beta 7GDP + \beta 8DUM + \beta 9POL + \varepsilon$$

Variables

For the empirical analysis 1 dependent variable (ROE – return on equity) is used as a profitability proxy for this research. ROE measures how well a company is exploiting shareholders' investments in the company.

For this study, capital adequacy, liquidity ratio, management efficiency, capital structure, and decision dividend policy were taken as firm-specific variables, while GDP growth, control of corruption, political stability, and tax rates were chosen as macroeconomic variables.

Firm-Specific Variables

As firm-specific variable, *capital adequacy* shows the firm's portion of the equity in the total assets. *The liquidity ratio* demonstrates the ability of the firm to produce enough cash to meet its short-term obligations. *The efficiency of financial management* shows how the managerial processes within the company affect financial performance. *The capital structure* shows the combination of the company's debt and equity required to finance its operations and growth. *The dividend policy* of the company can provide insight into the company's internal decisions on how to distribute profits.

Macroeconomic Variables

For the purposes of this study, *GDP* is taken to be a rate at which gross domestic product grows during the period of investigation. The term *corruption* can be defined as the tendency among public officials to accept bribes of different forms (gifts, payments, etc.) from companies in exchange for favorable conditions and the provision of a chance to survive in the marketplace. *Political stability* demonstrates the degree of instability/stability in terms of volatility in the political regime of the

countries. *Tax rates* indicate the portion of the corporate income to be paid to the government.

Hypotheses of the Study

H1: Liquidity has a negative impact on ROE (Li et al.*, 2020)*
*H2: Company size has a positive effect on ROE (*Akbas & Karaduman, 2012*)*
*H3: Management efficiency has a positive effect on ROE (*Ikapel et al., 2019*)*
H4: Dividend payout policy has a positive effect on ROE (Kafle, 2020*)*
*H5: Capital structure has a significant adverse effect on ROE (*Zhou & Sihombing, 2019*)*
H6: GDP has a significant and positive effect on ROE (Riaz and Mehar, 2013*)*
H7: Corruption level has a significant negative impact on ROE (Nam et al.*, 2016)*
H8: Political instability has a negative effect on ROE (Hosny, 2017*)*
*H9: Corporate tax rate has a negative impact on ROE (*Pitulice et al., 2016*)*

Empirical Results (Table 2)

In Table 2, a summary of descriptive statistics is presented. As indicated in Table 2, the mean value of ROE for 97 observations is −0.0198436, the minimum value is −2.6477, and the maximum value is 0.3319 with a standard deviation of 0.3967273. The negative mean value indicated that some companies were operating at loss.

The mean value for LIQ for 98 observations is 1.185487, the minimum value is 0.16 and the maximum value is 3.67 with a standard deviation of 0.6742583. This indicates that on average companies have sufficient current assets to pay for short-term liabilities.

Table 2 Descriptive statistics

```
. summarize ROE LIQ MGMT CAP DIV CADEQ GDP COR POL TAX
```

Variable	Obs	Mean	Std. Dev.	Min	Max
ROE	97	-.0198436	.3967273	-2.6477	.3319
LIQ	98	1.185487	.6742583	.16	3.67
MGMT	99	.0140349	.0782745	-.362325	.1345
CAP	96	.9479687	1.139819	-.0998	5.24
DIV	100	.067647	.1840865	0	1.11
CADEQ	94	.3770354	.1988672	-.15	.86
GDP	100	.0684433	.0177131	.023	.0955083
COR	100	.4564027	.0405553	.3791469	.5288462
POL	100	.3137852	.0508816	.2619048	.3857143
TAX	100	.13702	.176796	-.7434	.7426

The mean value for MGMT for 99 observations is 0.0140349, the minimum value is −0.362325, and the maximum value is 0.1345 with a standard deviation of 0.0782745. The positive return on assets shows that companies were profitable on average, but the negative minimum value indicates that some of them were operating at loss.

The mean value of CAP for 96 observations is 0.9479687, the minimum value is −0.0998, the maximum value is 5.24, and the standard deviation is 1.139819. The mean value which is close to 1 indicates that on average, companies are equally financed by debt and equity. A negative value of minimum value indicates that some companies in the sample have more liabilities than assets and a maximum value shows that some companies are highly levered.

The mean value of DIV for 100 observations is 0.067647, the minimum value is 0, the maximum value is 1.11, and the standard deviation is 0.1840865. The mean value demonstrates that on average companies were payout out 6.7% of net income. The minimum value indicates that some companies didn't pay dividends, while some companies were paying out more in dividends than their earnings.

The mean value for CADEQ for 94 observations is 0.3770354, the minimum value is −0.15, the maximum value is 0.86, and the standard deviation is 0.19886. Such results indicate that on average, companies financed 38% of their assets with equity with the highest portion of equity of 86% in some companies.

The mean value for GDP is 0.068443, the minimum value is 0.23, the maximum value is 0.095508, and the standard deviation of 0.01771.

COR mean of 100 observations is 0.4564, the minimum value is 0.37914, the maximum is 0.52884, and the standard deviation is 0.0405553. This shows that public power is exercised for private gain on average 45%.

POL mean of 100 observations is 0.3137853, the minimum value is 0.2619, the maximum value is 0.385714, and the standard deviation is 0.0508816. This means that on average, there is a 31% of probability of political instability in the country.

TAX mean of 100 observations is 0.13702, the minimum value is −0.07434, the maximum value is 0.7426 and the standard deviation is 0.1767. This means that on average, companies were taxed at a 14% rate.

Correlation, Autocorrelation, and Heteroscedasticity Tests

FGLS model assumes the existence of group-wise heteroscedasticity, autocorrelation, and multicollinearity tests. The tables below demonstrate the results of diagnostic tests.

Table 3 indicates that a high correlation is not observed between variables. Results in Table 4 show that all the variables show a VIF less than 5 (except for GDP), which is an acceptable level of multicollinearity.

The probability value of chi2 in the heteroscedasticity test was significant, which reveals the presence of heteroscedasticity in the data analyzed with regression results.

Table 3 Correlation

	ROE	LIQ	MGMT	CAP	DIV	CADEQ	GDP	COR	POL	TAX
ROE	1.0000									
LIQ	0.2662	1.0000								
MGMT	0.7719	0.3306	1.0000							
CAP	0.0248	-0.3222	-0.1429	1.0000						
DIV	0.1131	0.2062	0.1292	-0.0677	1.0000					
CADEQ	0.3408	0.7533	0.3346	-0.4952	0.0912	1.0000				
GDP	-0.0395	-0.1017	-0.1376	0.0325	-0.2065	-0.0543	1.0000			
COR	0.1199	0.0387	0.1991	0.0068	0.1036	0.0506	-0.8264	1.0000		
POL	0.0260	0.0568	0.1874	-0.1052	0.1726	0.0290	-0.5958	0.3190	1.0000	
TAX	0.2160	0.2603	0.2348	-0.1579	0.0907	0.2041	-0.0194	-0.0694	0.1348	1.0000

Table 4 Variance inflation factor

```
. estat vif
```

Variable	VIF	1/VIF
GDP	5.67	0.176322
COR	4.15	0.241104
CADEQ	2.89	0.345771
LIQ	2.58	0.387013
POL	1.96	0.510408
CAP	1.37	0.730838
MGMT	1.31	0.760525
TAX	1.15	0.870803
DIV	1.11	0.898289
Mean VIF	2.47	

The test produced a chi-square value of 296.63 with a p-value of 0.0000.

$$Likelihood-ratio\ test \qquad LR\,chi2(104) = \quad 296.63$$

$$(Assumption: homo\ nested\ in\ hetero) \qquad Prob > chi2 = \quad 0.0000$$

Wooldridge test indicated autocorrelation in panel data for all the variables as the probability value was less than 10% (Table 5).

The results demonstrated in Table 6 indicate that

- *Liquidity (LIQ)* has a coefficient of −0.0055166 with a p-value of 0.419. Such results show that liquidity has a negative and insignificant impact on ROE. This can be interpreted as holding too many liquid assets can negatively affect the financial performance of companies. Excess cash and receivables can lead to lost profits.
- The results above are not consistent with the empirical results of Li et al. (2020) stating that liquidity has a significant adverse impact on ROE.
- H1 hypothesis can be accepted.
  - *Management efficiency (MGMT)* has a coefficient of 2.150289 with a p-value of 0.0000. Such results show that management efficiency has a positive and

Table 5 Autocorrelation test results

```
. xtserial ROE LIQ MGMT CAP DIV CADEQ GDP COR POL TAX

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,       9) =      3.873
          Prob > F =      0.0806
```

Table 6 FGLS regression results

```
Coefficients:  generalized least squares
Panels:        heteroskedastic
Correlation:   common AR(1) coefficient for all panels  (0.2836)

Estimated covariances      =        10          Number of obs     =        92
Estimated autocorrelations =         1          Number of groups  =        10
Estimated coefficients     =        10          Obs per group:
                                                              min =         4
                                                              avg =       9.2
                                                              max =        10
                                                Wald chi2(9)      =   3920.67
                                                Prob > chi2       =    0.0000
```

ROE	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
LIQ	-.0055166	.0068309	-0.81	0.419	-.018905	.0078717
MGMT	2.150289	.0398321	53.98	0.000	2.07222	2.228359
CAP	.0041527	.0051662	0.80	0.422	-.0059729	.0142783
DIV	-.0241571	.0074944	-3.22	0.001	-.0388459	-.0094682
CADEQ	-.0606488	.0282726	-2.15	0.032	-.1160621	-.0052355
GDP	-.4416099	.2171214	-2.03	0.042	-.8671601	-.0160598
COR	-.0559776	.0954459	-0.59	0.558	-.243048	.1310929
POL	-.0578188	.0459577	-1.26	0.208	-.1478943	.0322566
TAX	-.0278205	.0184798	-1.51	0.132	-.0640402	.0083992
_cons	.1188448	.0675359	1.76	0.078	-.013523	.2512127

significant impact on ROE. Such a relationship can be explained by the fact that more efficient management of company assets can lead to increased profit. These findings are consistent with the conclusion of Ikapel et al. (2019) about a strong and positive correlation between management efficiency and ROE.

– H3 hypothesis can be accepted.

  – *Capital Structure* has a coefficient of 0.0041527 with a p-value of 0.422. Such results show that capital structure has a positive and significant impact on ROE. This is not in line with the study results of Gunawan and Daulay (2016) that found that capital structure has a significant and negative impact on ROE.

– H5 hypothesis can be rejected.

  - *The dividend payout policy* has a coefficient of −0.0241571 and a p-value of 0.001. Such results show that the dividend payout policy has a negative and insignificant impact on ROE. Paying out dividends reduces retained earnings and thus leads to decreased ROE. The results are in line with the conclusion of Nguyen et al. (2021) stating that dividend payment decision negatively and significantly affects the ROE of companies.

- H5 hypothesis can be rejected.
  - *Capital adequacy* has a coefficient of −0.0606488 with a p-value of 0.032. This indicates that capital adequacy has a negative and insignificant impact on ROE. Such results are consistent with the findings of Becker-Blease et al. (2010) revealing that there is a negative and significant relationship between company size and ROE.

- H2 hypothesis can be rejected.
  - *GDP* has a coefficient of −0.4416099 with a p-value of 0.042. This means that GDP growth has a negative and insignificant impact on ROE. Such impact can be explained by the rapid growth of the Chinese economy where new companies are entering the market and creating higher competition for existing ones.

- The above results are not consistent with the study of Liu et al. (2021) which concluded that the ROE of 39 Chinese companies was not affected by the GDP growth variable.

- H6 hypothesis can be rejected.
  - *Control of corruption* has a coefficient of −0.0559776 with a p-value of 0.558. This demonstrates that control of corruption has a negative and insignificant impact on ROE. A higher extent of corruption leads to reduced ROE of companies. Such results are not consistent with the research of Williams and Martinez-Perez (2016), which concluded that corruption positively and significantly affects the ROE of companies in the sample.

- H7 can be rejected.
  - *Political instability* has a coefficient of −0.0578188 with a p-value of 0.208. According to such results, political stability has a negative and insignificant impact on ROE. As the likelihood of political instability rises, the ROE of companies goes down. Hosny (2017) got the same relationship between political stability and ROE in the study of private firms in eight countries in the Middle East and North Africa.

- H8 hypothesis can be accepted.
  - *Tax rate* has a coefficient of −0.0278205 with a p-value of 0.132. This is an indication of a negative and insignificant impact of the tax rate on ROE. Higher tax rates reduce the profitability of the companies. This contradicts the findings of Otwani et al. (2017) who revealed a positive relationship between corporate income tax and the ROE of companies in his research sample.

Table 7 Time dummy results

```
. regress ROE LIQ MGMT CAP DIV CADEQ GDP COR POL TAX _IYear_2018 _IYear_2019 _IYear_2020
```

Source	SS	df	MS	Number of obs	=	92
				F(12, 79)	=	14.51
Model	10.3313377	12	.86094481	Prob > F	=	0.0000
Residual	4.68669697	79	.059325278	R-squared	=	0.6879
				Adj R-squared	=	0.6405
Total	15.0180347	91	.165033348	Root MSE	=	.24357

ROE	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LIQ	-.0966815	.0603918	-1.60	0.113	-.2168885	.0235254
MGMT	3.907007	.3768736	10.37	0.000	3.156859	4.657155
CAP	.0818447	.0261037	3.14	0.002	.0298866	.1338029
DIV	.0720115	.1438453	0.50	0.618	-.2143053	.3583284
CADEQ	.6328965	.2285895	2.77	0.007	.1779004	1.087893
GDP	-7.733857	10.23876	-0.76	0.452	-28.11361	12.64589
COR	-1.981108	2.237619	-0.89	0.379	-6.434977	2.47276
POL	-.5678799	.8709751	-0.65	0.516	-2.301512	1.165753
TAX	.1747412	.1502266	1.16	0.248	-.1242774	.4737599
_IYear_2018	-.0354346	.1012235	-0.35	0.727	-.2369149	.1660456
_IYear_2019	-.2905566	.1610843	-1.80	0.075	-.6111868	.0300736
_IYear_2020	-.2468056	.3598083	-0.69	0.495	-.9629862	.469375
_cons	1.353553	1.892518	0.72	0.477	-2.41341	5.120516

– H9 hypothesis can be accepted (Table 7).

According to regression results, the *Year 2019* had a negative and insignificant impact on ROE. This can be explained by China's trade war with the USA which escalated in 2019. US and China both have imposed bilateral tariffs on goods imported from each other. As a result, Chinese manufacturers were forced to move their operations to the higher-production-cost but tariff-free countries.

Test of Agency Cost Theory: Dividend Policy

This study investigates the agency theory regarding dividend payout policy. The agency theory states that there is an issue of conflicts of interest between management and shareholders of the company. To reduce agency costs, one of the solutions provided can be paying out cash available to management in the form of dividends. Therefore, the payment of high dividends reduces retained earnings, and this leads to reduced ROE. Cash leaving the firm in form of dividends also turns down investment opportunities. This can negatively affect companies' growth and development.

According to results obtained in this study, dividend payout policy has a *significant negative* impact on ROE which states that with one unit increase in dividend payout ratio, there is a decrease in ROE. So, the decision to reduce agency costs does not lead to owners' wealth maximization. Such findings are not in line with agency cost theory.

Conclusion and Recommendations

As the interest of investors in renewable energy sources is increasing it is important to study the determinants of the financial performance of companies operating in this industry.

To summarize the findings of this study, it can be concluded that management efficiency, dividend payout policy, capital adequacy, GDP growth, political stability, and tax rate have a significant impact on the ROE of companies in the sample. All the mentioned determinants have a negative impact on ROE except for management efficiency, whose impact was positive. Capital structure, liquidity, and control of corruption affecting variables had an insignificant impact on ROE.

Based on the finding of this study it can be recommended that proper management of companies' assets is to be established as the effect of management efficiency is significant.

Liquidity (current ratio) of the companies should be managed in a way that too many liquid assets are not kept inside the companies.

The dividend payout policy should be applied using a proper model that can lead to stable, long-term, and transparent payment of dividends with adequate authority and permission from management. Shareholders should be informed about the negative impact of a higher payout ratio on ROE so they can decide if they want to keep a high ratio or retain more cash with the company for development.

Capital adequacy should be kept on a relevant level with a proper amount of equity financing of assets. As a higher equity-to-assets ratio decreases ROE, companies should consider the proper amount of debt financing.

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Does the IFRS16 Matter in Determining the Profitability of Airline Industries?

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Abstract The purpose of this study is to reveal the effect of IFRS 16 Leases implementation on the profitability of airline companies all over the world. The research is based on the panel data statistics of 357 airline companies in 59 countries all over the world. The time period used is seven years between 2013 and 2019 for all variables. The findings support the goal of the International Accounting Standards Board to improve the transparency of financial statements and provide the users of financial statements with more credible and comparative financial information and figures. The results of the study indicate that off-balance sheet leases capitalization due to IFRS 16 provides more relevant information than IAS 17. As it was expected, the solvency ratio has an insignificant impact on return on equity. Additionally, the positive significant impact of the share price on the company's profitability was revealed. The results indicate that in 2019 there was a decrease in the profitability of the firms. However, it is suggested that such numbers were obtained due to global macroeconomic factors such as COVID-19 pandemics or severe oil price fluctuations that influence the world economy and specifically the airline industry.

Keywords IFRS16 · Profitability · COVID-19 · Oil price · Airline industry

Introduction

Lease agreements are actively used by a wide range of companies from various industries such as retail, airline, and others and have been accepted as a common source of assets funding for organizations. Leasing contracts became increasingly popular today, since, due to high investment requirements, companies prefer to lease aircraft rather than buy (Bourjade et al., 2017). The proportion of leased

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aircraft rose dramatically during the last fifty years increasing from 0.5% in 1970 and reaching 40% in 2015 (Bourjade et al., 2017).

IAS 17, the standard regulating accounting principles for leases, has always been criticized by users for not reflecting the true picture of economic and financial reality. In January 2016 International Accounting Standards Board, an independent accounting standards-setting body, published a new accounting standard IFRS 16 Leases to be implemented from the beginning of 2019. The standard was supposed to bring enormous adjustments to lease recognition, measurement, and disclosures, specifically accounting for operating leases. The standard is aimed at faithful representation of lease contracts and should assist users of financial statements in the proper estimation of timing and amount of leases. Consequently, lessees have to reflect on the right to use assets and associated liabilities emerging from transactions.

According to the new standard, the difference between operating and finance lease would be excluded and the lessee will be obliged to capitalize all leases. However, there is a certain exception. First, short-term lease arrangements with a duration of up to 12 months. Secondly, leases of low value should not be capitalized. Such leases should be expensed in the period incurred on the basis of the straight-line depreciation method. Moreover, the standard introduces a new term known as "right-of-use asset" to be capitalized for all leases. Along with this asset, the lease liability should be recorded on the balance sheet. Previously recorded periodical expenses will be replaced by depreciation expenses on right-of-use assets and finance charges. Employing a new lease model, International Accounting Standards Board aims the elimination of off-balance sheet reporting and more transparent and fair representation of financial statements.

Research Question

Application of IFRS 16 in the financial statements of companies is expected to bring substantial increases in assets and liabilities of firms and cause essential changes in key figures of the effectiveness of income statements for companies with sufficient amounts of off-balance sheet arrangements. According to IASB (2016), the industries which will be affected by the implementation of IFRS 16 are airlines, retail, travel, and leisure.

This study aims to investigate the profitability determinants of airline companies specifically the IFRS 16 Leases standard. To sum up, the following research question can be formulated:

What factors influence the profitability of airline companies, including the implementation of the IFRS 16 Leases standard?

Research on this topic is essential since profitability is the main objective of any business. Estimating current profitability and making projections on future profitability is a significant issue since without generating profits the company will not survive in the long run (Hofstrand, 2006). Moreover, according to IASB, more than one hundred and fifty countries worldwide are required or permitted to use

international financial reporting standards. Consequently, changes in IFRS standards affect more than 27,000 domestically listed companies all over the world (IASB, 2018).

Leases and Accounting Standards

Introduction to Leases

During the last decades, lease agreements have become widespread and preferred more than common debt financing. Unfortunately, bank loans are not available for all small and medium enterprises, while companies are often in need of property and equipment used in daily operations. Leasing agreements emerged as a solution to this kind of issue. Research performed by Lin et al. (2013) examined the reasons why companies choose financing types between leasing and debt. Authors believe that these alternatives are substitutes and firms with financial constraints are willing to choose to lease over debt financing. Another study by Morais et al. (2014) claims that the choice between lease and debt depends on several factors such as firm size, taxation policies, and constraints. However, lease financing is more preferable than debt financing in some industries such as retail, utilities, and air transport. Research performed by Deloof et al. (2007) observed 1119 Belgian small and medium enterprises and agreed that debt and lease are substitutes, and consequently, more leases are associated with less debt. Moreover, researchers argue that the preference for lease over debt is explained by tax advantages gained.

Lease agreements boost numbers all over the world. For instance, the European leasing market reached €715.3 billion in 2020, while the new lease volume is calculated as €351.9 billion that year (Leaseurope, 2020). However, these numbers are about 14% lower than the 2019 figures. The reason for such decline can be explained by the COVID-19 pandemic due to which strict lockdown was introduced all over the world for about half a year.

Figure 1 below demonstrates the annual growth rate of the lease market in Europe. With an exception to the global crisis in 2008–2009 and the COVID-19 pandemic, the lease market shows consistent growth on a yearly basis.

Comparison Between IAS 17 and IFRS 16

IFRS 16 issued by International Accounting Standards Board as an improved standard to replace IAS 17 was developed jointly with Financial Accounting Standards Board. IFRS Foundation issued a new standard in January 2016 to be effective from January 1, 2019 and afterward with or without retrospective adjustments. The company can adopt the standard before that date in case of application of IFRS 15 Revenue from contracts with customers.

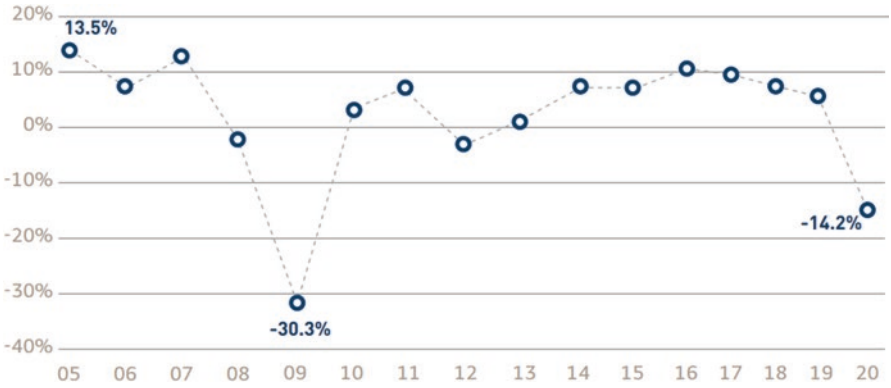

Fig. 1 Annual growth rate of lease market in Europe between 2005 and 2020. (Source: leaseurope.org)

Table 1 Comparison of statements effects under old and new standard

IAS 17		IFRS 16	
Balance sheet		*Balance sheet*	
Assets	Assets	Assets	Liabilities
No effect	Right-of-use asset	Right-of-use asset	Lease liability
IAS 17		IFRS 16	
Income statement		*Income statement*	
Rental expense		Depreciation expense Finance costs	

IFRS 16 specifies the recognition, measurement, presentation, and disclosure matters of leases. Standard provides a single accounting model for the lessee which requires recognition of lease assets and liabilities for all arrangements, with an exception for leases with a term less than 12 months and leases of low value. The approach to an accounting of lessor was not significantly modified in comparison with IAS 17. Lessor shall continue to classify lease either as operating or finance. However, disclosure requirements are changed to release additional information on risk management regarding the lessor's share in leased assets.

The objective of IFRS 16 is to establish "principles for the recognition, measurement, presentation and disclosure of leases, with the objective of ensuring that lessees and lessors provide relevant information that faithfully represents those transactions" [IFRS 16:1].

The new standard is assumed to bring enormous changes to leasing activities due to the elimination of classification as operating or finance lease. Thus, the lessee recognizes all lease contracts as finance leases. As a result, off-balance sheet reporting would be eliminated and it would bring significant changes in the statement of financial position, cash flow statement, and statement of profit or loss (Table 1).

According to IFRS 16, the company should recognize lease assets calculated as the present value of future lease payments. Lease liabilities also must be presented

on the balance sheet as a long-term obligation. Moreover, depreciation expense on right-of-use assets and finance costs should be presented on the income statement. Regarding cash flow statements, companies should divide total cash paid into principal amount and interest and show them separately.

The principles of accounting by the lessor did not sufficiently change with an exception for guarantees of residual value. The new standard requires recognition only of expected residual value guarantees to be paid in place of maximum pledges sum as was required by the old standard. Moreover, as it was already mentioned, there was an improvement regarding the lessor's disclosure requirements.

Literature Review

Impact on Financial Indicators and Financial Statements from Adoption of IFRS 16

Various studies were undertaken during the last years in order to determine the effect of off-balance sheet lease capitalization on the financial statements of firms. Data observed in studies indicate that huge numbers were hidden from users of financial statements that could possibly mislead their decisions. As an example, the earliest research on lease capitalization performed by Nelson (1963) examined financial statements of eleven American companies which reported the information on changes in figures from capitalization of unrecorded lease obligations. The findings indicated that lease capitalization significantly affected key financial ratios of companies and the figures presented on the balance sheet could mislead users of financial statements.

Imhoff et al. (1993) performed a detailed investigation of the effect of lease recognition on firms' statements. The authors studied 80 companies in the aviation and retail industries between 1984 and 1990. Off-balance sheet leases capitalization influenced all financial ratios. For instance, the return on assets and debt-to-assets ratio showed growth of 2% and 11.8%, respectively. However, the return on equity ratio decreased by 21.4%.

A study performed by Ozturk and Sercemeli (2016) aimed the investigation of lease capitalization on financial indicators of Pegasus Airline, a Turkish airline company. The authors concluded that the assets and liabilities of Pegasus Airlines will increase by 29.3% and 52.2%, respectively, as a result of IFRS 16 implementation. The impact on shareholders' equity was computed as a 12.5% decrease. The influence on the financial ratio was also substantial. For example, debt-to-equity ratio and debt-to-asset ratio raised by 75.3% and 16.9%. However, the return on assets ratio experienced a decrease of 34.4%.

Another recent research performed by Veverkova (2019) also focused on the aviation industry whereby there was a sample of 15 airline companies, on which a median increase of total assets was seen at 25.71%. The study showed also a median decrease of 20.94% in ROA and 15.94% in ROE indicators.

Caster et al. (2018) performed a study of 10 American airlines and calculated the effect of off-balance sheet lease capitalization. Used measures included current ratio, asset turnover, return on assets, times interest earned, and debt ratio. The authors supported the idea of significant changes in financial indicators and found out that some airline companies met dramatic changes in their ratios. For example, Spirit Airlines had about a one-third decline in the current ratio. The most impressive change was in the asset turnover calculation of Virgin America airlines. The ratio experienced a significant decline of about 50%, turning from 0.48 to 0.98.

Khersiat (2020) conducted a study to reveal the impact of IFRS 16 adoption on Royal Airlines of Jordan. The author compared 2018 and 2019 financial statements in order to find out the statistical impact of the standard on accounting conservatism at Royal Jordanian Airlines. The Pearson correlation based on the BASU model and accrual model was used. The author concluded that there was no significant influence of accounting conservatism on the statement of financial position of Jordanian airlines after the adoption of the IFRS 16 standard.

Magli et al. (2018) analyzed the potential influence of the implementation of new leases standard on the leverage and performance of 113 Italian companies. The quantitative data from annual reports of companies included future lease payments, revenues, total assets, and equity. As a result, the authors tried to analyze the amount of right-of-use assets recognized after standard application, the impact on profitability, and information that will be available for the users of financial statements. The research concludes that the impact of IFRS 16 adoption on financial statements is significant. Specifically, the companies were expected to experience a dramatic increase in lease assets and liabilities and a decrease in equity. Regarding the income statement, the companies were expected to have a raise in earnings before interest and tax and also increases in finance costs. Retail and telecommunication industries were named as those which will be affected the most. The authors computed the discounted minimum lease payments to be 131.9 billion. On average, earnings before interest and tax increased by 14% under IFRS 16 adoption, while the increase in debt-to-equity ratio was equal to 6% due to an increase in total liabilities by 23%.

Stancheva-Todorova and Velinova-Sokolova (2019) studied the impact of IFRS 16 on ratios, metrics, and financial reporting. The authors concluded that there would be an increase in companies' assets and liabilities and a reduction in shareholders' equity. Moreover, researchers claim that IFRS 16 adoption will decrease the outflows in operating cash flows and increase financing outflows.

Susanti et al. (2020) selected one airline company from the Indonesian Stock Exchange and aimed to find the influence of new standard applications on the financial ratios of companies. The selected company was PT Garuda Indonesia Tbk since the company mostly applied operating lease accounting in its financial statements and posted information related to its leasing activities. The authors revealed that changes in the financials of the company were significant with dramatic rise in operating income. Moreover, the research shows a sufficient increase in the assets and liabilities of the company, while equity experiences a decrease. The results demonstrate that net cash flow from operating activities has risen, while cash flow from financing activities has decreased. Researchers compared the key financial ratios

before and after the implementation of the standard and revealed that the debt-to-equity ratio showed a significant increase of 10.875%, while the return on equity increased by 5.493%. The decrease in return on assets ratio equaled 39% and asset turnover decreased by 49%.

Wong and Joshi (2015) studied the impact of off-balance sheet lease capitalization on financial statements and key ratios. The authors have chosen 170 companies listed on the Australian Stock Exchange in the year 2010. The companies represented different industries such as health care, energy, telecommunications, utilities, and others, with market capitalization higher than $1000 million. The study has also employed the constructive lease recognition approach invented by Imhoff et al. (1991). The results show that the value of unrecorded lease liabilities of sample companies equaled $679 million. As per previous research, this study shows an increase in assets and liabilities, but a decrease in companies' equity due to IFRS 16 application. The authors concluded that on average, debt-to-equity and debt-to-asset ratios experience 31.69% and 10.11% increase, respectively. However, return on assets and return on equity shows a decrease of 15.35% and 1.23%, respectively.

Agency Theory

Agency relationship takes place when one party (agent) acts on behalf of another party (principal). In the business world of companies, shareholders are the principal, while top management acts as an agent (Adebayo & Lateef, 2017). The statements function as an instrument for management reporting to shareholders. One of the main objectives of a shareholder is profit maximization. Agency theory represents the concept that the main goal of an agent acting in the best interest of shareholders is the maximization of profits (Spake et al., 1999). Consequently, research on profitability drivers may be consistent with agency theory.

Hypotheses of the Study

IFRS 16 has brought fundamental changes to the financial statements of the companies due to the capitalization of almost all leasing agreements. As it was discussed in the literature review, lease capitalization influences statements of financial position, statements of profit or loss, and financial indicators and ratios. Special attention is paid to companies in the airline, retail, and travel and leisure industries. According to EY research (2019), the average increase in companies' assets equals 20%, while the rise in liabilities is estimated to be about 40%.

International Accounting Standards Board expects IFRS 16 Leases to bring a more transparent and comparable view of financial statements for the purpose of better understanding and improvement of the decision-making process for investors and users of financial statements. Elimination of off-balance sheet leasing

agreements and their effect on cash flows will allow analysts to better evaluate the risk and profitability of the firms.

According to IFRS 16 effect analysis performed by IASB (2016a; b), the overall profitability after implementation of the standard depends on the lease portfolio of a particular company, with an increase in return-on-equity ratio in case of a minor effect on profit or loss.

Regarding liquidity represented by the current ratio, it is assumed that the current ratio will go down since current liabilities will increase with the implementation of the standard, while current assets do not change.

IFRS 16 requires the capitalization of leases into a right-of-use asset, which has to be shown as part of property, plant, and equipment on the statement of financial position. Consequently, the amount of fixed assets rises. Simultaneously, lease capitalization results in the recording of the lease liability.

Talking about the solvency ratio, the effect of lease capitalization and further recording of associated liability is believed to be insignificant. The increase in an asset can smooth the rise in liabilities, and hence asset-based solvency ratio will not be changed essentially.

There is a variety of measures leading to an increase in the company's stock price. Obviously, a rising stock price reflects the expectation of investors on the profitability of the firm. So it is assumed that increasing stock price leads to an increase in profitability.

The next independent variable taken is an oil price change. Oil is one of the most important commodities, it is used as raw material for a variety of products such as plastics, clothes, pharmaceuticals, and others. For the purposes of this study, it is predicted that an increase in oil prices has a significantly positive effect on the profitability of companies.

The government effectiveness index, created by World Bank, calculates overall government quality on a scale from −2.5 (less effective) to 2,5 (more effective). It includes such indicators as political stability, level of corruption, and effectiveness of public services. A higher government effectiveness index indicates a more developed economy and therefore is assumed that companies working in such an environment are expected to have higher reporting profits.

One more macroeconomic factor that can influence the profitability of the firms is the gross domestic product. Usually, an increase in GDP indicates an expansion of the economy and consequently, the creation of new working places and better pay for employees. So, an increase in GDP can positively and significantly influence the profitability of the companies.

Another issue that is tested in research is agency theory. As it was already mentioned, the statements represent the instrument for top management to report to shareholders under an agency theory. The point is whether the implementation of IFRS 16 impacts the profitability of airline companies and agency issues positively.

Summing up the previous discussion on points influencing the profitability of the company, this research paper sets and examines the following hypotheses:

- H1: Implementation of IFRS 16 Leases has a significant negative effect on the profitability of the company, decreasing its return on equity ratio.
- H2: Growth in the current ratio has a significant positive effect on the profitability of airline companies due to the implementation of IFRS 16.
- H3: An increase in fixed assets has a significant positive effect on return on equity.
- H4: Rise in solvency ratio has an insignificant negative effect on return on equity.
- H5: Growth in share price significantly affects return on equity and has a positive effect on it.
- H6: Oil price increase has a significant positive effect on the company's profitability.
- H7: Higher government effectiveness index has a significant positive effect on return on equity.
- H8: An increase in a country's GDP has a significant positive effect on a company's profitability.
- H9: Dummy variable has a significant impact on the profitability of the firm. It affects the company's profitability in a negative path.

Methodology

The purpose of this study is to reveal the effect of IFRS 16 Leases implementation on the profitability of airline companies all over the world.

The research is based on the panel data statistics of 357 airline companies in 59 countries all over the world. The time period used is seven years between 2013 and 2019 for all variables. The study is based on data collected from companies' year-end financial statements and information from the World Bank database.

The following regression model was used to understand the effect of IFRS 16 implementation on the profitability of airline companies:

$$\begin{aligned} \mathrm{ROE} = {} & b_0 + b_1(\mathrm{LNCAR}) + b_2(\mathrm{LNFIX}) + b_3(\mathrm{SOLV}) + b_4(\mathrm{LNPRICE}) \\ & + b_5(\mathrm{OILPRICECH}) + b_6 \\ & (\mathrm{GOVEX}) + b_7(\mathrm{LGDP}) + b_8(\mathrm{INTERDUMMY}) + b_8(\mathrm{DUM}) + \mathrm{E} \end{aligned}$$

In the regression model above, β_0 is a constant variable, while variables from β_1 to β_8 are coefficients of independent variables and E is an error term. For variables, and definitions refer to Table 2 below.

Variables

The following table shows the description of symbols and variables used in the analysis:

Table 2 Description of symbols and variables used

Symbol	Variable	Proxy
Dependent variables		
ROE	Return on equity	Net income/shareholders' equity
Independent variables		
LNCAR	Current ratio	Current assets/current liabilities natural logarithm
LNFIX	Fixed assets	Property, plant, and equipment natural logarithm
SOLV	Solvency ratio	Total debt/total assets
LNPRICE	Share price	Share price natural logarithm
OILPRICECH	Oil price	Oil price change (%)
GOVEX	Government effectiveness index	Value from −2.5 to 2.5
LGDP	GDP growth	GDP logarithm
DUM	Dummy variable	1 = year 2019, 0 = other years
INTERDUMMY	Value of property, plant, and equipment in 2019	Dummy*LNFIX

Current ratio: Current ratio natural logarithm was used. It is a liquidity ratio that measures a company's ability to repay its short-term obligations.

Fixed assets: Company's property, plant, and equipment figure taken as a natural logarithm. It includes a Right-of-Use asset, which appears due to the implementation of IFRS 16 in 2019.

Solvency ratio: Solvency ratio based on assets in denominator. It shows the proportion funded by debt and the ability of the company to repay its debt with available assets.

Share price: Price of company's shares. Available only for companies, which are public and therefore are traded on the stock exchange. Then the number is taken as a natural logarithm.

Oil price: Average Brent oil prices were taken and then the change from the previous year was calculated in percentages.

Government effectiveness index: Government effectiveness index extracted from the World Bank database. Countries are ranked from −2.5 (less effective) to 2.5 (more effective) each year.

GDP growth: GDP figures measured in constant 2015 US$ rate. Then the number is taken as a natural logarithm.

Dummy variable: Dummy variable was used to distinguish between years without the IFRS 16 effect (2013–2018 inclusively) and with an implementation of the standard (2019). Therefore, 2019 year figures receive 1, while others 0.

Interdummy variable: Dummy variable was used to observe the effect of IFRS 16 implementation. Received by multiplication of dummy by fixed assets natural logarithm.

Sample Composition and Size

As it was mentioned, the sample size consisted of 357 airline companies representing 59 countries all over the world. The following table summarizes countries and airline companies and shows the percentage of each country included in the sample.

Research Results

Table 3 above shows the descriptive statistics of the independent and dependent variables applied in the research model. There is a minimum of 1831 observations which stand for share price and can be explained in the way that not all companies from the sample are listed on the stock exchange. The greatest number of observations is 2299, which belongs to the solvency ratio, oil price change, and dummy variable. All mean figures for variables are positive with the highest mean for solvency ratio which equals 39.4511. The lowest average indicator stands for oil price change equal to 0.0049 with a standard deviation of 0.2475. The standard deviation is the highest for profitability with the value of 72.6634, while the minimum and maximum figures also belong to ROE and are equal to −944.4820 and 892.7540, respectively. The conclusion can be made that there is a high variation among variables implying a bigger spread around mean values. The only column with negative results is the minimum value.

Correlation, Autocorrelation and Heteroscedasticity Tests

It is important to ensure that multicollinearity, autocorrelation, and heteroscedasticity tests are performed, and all related errors are eliminated.

Table 3 Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
ROE	2192	3.4369	72.6634	- 944.4820	892.7540
LNCAR	2296	0.3142	0.7714	- 3.7297	4.4904
LNFIX	2275	11.8662	3.0523	0.5929	18.0471
SOLV	2299	39.4511	25.4285	- 91.8990	99.3140
LNPRICE	1831	1.2198	2.3596	- 7.3917	7.3502
OILPRICECH	2299	0.0049	0.2475	- 0.4710	0.4000
GOVEX	2293	0.7732	0.8009	- 1.1900	2.2400
LGDP	2293	7.5528	1.9028	- 1.3056	9.9022
INTERDUMMY	2275	1.4263	4.0132	0	17.6482
DUM	2299	0.1196	0.3246	0	1.0000

A correlation test should be performed to avoid a high correlation between independent variables. The table below summarizes the correlation results (Table 4).

The correlation matrix shows a positive correlation between dependent variable ROE and independent variables current assets (LNCAR), fixed assets (LNFIX), share price (LNPRICE), and gross domestic product (LGDP). The correlation of profitability with other variables (SOLV, OILPRICECH, GOVEX, DUM, INTERDUMMY) is negative. The greatest correlation ROE has with property, plant, and equipment – is 24.9%. These fixed assets include right-of-use asset which represents lease assets that emerged due to IFRS 16 implementation (Table 5).

Mean VIF should be less than 5, while the result received is 4.93, consequently, multicollinearity is at the acceptable level (Table 6).

Wooldridge test demonstrates that there is no autocorrelation in panel data since the p-value is greater than significance levels (1%, 5%, or 10%). According to the

Table 4 Correlation matrix

	ROE	LNCAR	LNFIX	SOLV	LNPRIC	OILPRI	GOVEX	LGDP	INTERD	DUM
ROE	1.000									
LNCAR	0.054	1.000								
LNFIX	0.249	−0.432	1.000							
SOLV	−0.072	0.641	−0.549	1.000						
LNPRICE	0.166	0.069	0.353	−0.112	1.000					
OILPRICECH	−0.033	−0.004	−0.003	0.019	−0.020	1.000				
GOVEX	−0.040	0.044	0.087	−0.100	0.,402	−0.019	1.000			
LGDP	0.004	0.072	0.155	−0.044	0.332	−0.004	0.156	1.000		
INTERDUMM	−0.005	−0.078	0.086	−0.075	0.022	0.013	0.040	0.041	1.000	
DUM	−0.034	−0.026	−0.012	−0.021	−0.021	0.012	0.037	0.021	0.965	1.000

Table 5 Variance inflationary factor

Variable	VIF	1/VIF
INTERDUMMY	16.9	0.059186
DUM	16.77	0.059625
SOLV	2.05	0.48,882
LNCAR	1.86	0.537,133
LNFIX	1.86	0.53,832
LNPRICE	1.54	0.648,175
GOVEX	1.22	0.817,942
LGDP	1.14	0.8794
OILPRICECH~E	1	0.9985
Mean VIF	4.93	

Table 6 Woolridge test

H0: no first-order autocorrelation
F(1, 8) = 2.895
Prob > F = 0.1273

heteroscedasticity test, LR chi2(8) equals 286.22, while Prob > chi2 equals 0, consequently, there is heteroscedasticity since the p-value is less than 1%.

Table 7 above shows the results of the heteroscedasticity test. The heteroscedasticity test indicates that "homo nested in hetero." LR chi2 (8) = 286.22, while Prob>chi2 equals to 0 (Table 8).

The figure above demonstrates the results of regression analysis between dependent and independent variables using the panel-corrected standards error model. According to the regression analysis, all the independent variables are significant since the p-value is less than the levels of significance (1%, 5%, 10%). Specifically, the current ratio, fixed assets, stock price, government effectiveness index, and gross domestic product have 0 p-values. Moreover, solvency ratio, oil price change, government effectiveness index, gross domestic product and dummy variable have a negative influence on the profitability of airline companies.

Table 7 Heteroscedasticity test

Likelihood-ratio test	LR chi2(8) = 286,22
(Assumption: homo nested in hetero)	Prob > chi2 = 0

Table 8 Regression analysis by employing panel-corrected standards error model

				max =	214
Estimated covariances	=	45	R-squared	=	0.1141
Estimated autocorrelations	=	0	Wald chi2(9)	=	404.46
Estimated coefficients	=	10	Prob > chi2	=	0.0000

PCSE MODEL

ROE	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
LNCAR	21,07118	2,080669	10,13	**0,0000*****	16,99315	25,14922
LNFIX	6,975711	0,5485411	12,72	**0,0000*****	5,90059	8,050831
SOLV	-0,1698517	0,0823962	-2,06	**0,0390****	-0,331345	-0,008358
LNPRICE	3,446881	0,7042175	4,89	**0,0000*****	2,06664	4,827122
OILPRICECHANGE	-8,90088	3,141496	-2,83	**0,0050*****	-15,0581	-2,743662
GOVEX	-10,86387	1,923746	-5,65	**0,0000*****	-14,63434	-7,093398
LGDP	-2,84087	0,7040292	-4,04	**0,0000*****	-4,220742	-1,460998
INTERDUMMY	1,619233	0,5971934	2,71	**0,0070*****	0,448755	2,78971
DUM	-23,90879	7,757628	-3,08	**0,0020*****	-39,11347	-8,704123
_cons	-55,55	10,00315	-5,55	**0,0000*****	-75,15581	-35,94419

* Statistical significance at the 10% level.

** Statistical significance at the 5% level.

*** Statistical significance at the 1% level.

The regression model implies that the current ratio has a positive significant effect on the profitability of companies. Sunjoko and Arilyn (2016) arrived at the same result in the research study of pharmaceutical companies listed on the Indonesia Stock Exchange. The research findings stated that fixed asset turnover and current ratio affect profitability significantly. However, research performed by Qamara et al. (2020) concluded that the current ratio does not affect the profitability of the firms.

The fixed assets have a significant influence on airline profitability and increase return on equity by 6.97%. The same conclusion was drawn from research performed by Alahyari (2014). Airline companies usually have a great amount of property, plant, and equipment which is used in operations and produce cash flows and profits for the company.

Solvency is an indicator of how successfully a company's cash flows can repay its non-current debt. However, the regression result indicates that it has a positive, but insignificant effect on the company's profitability. The conclusion is consistent with the research of Dahiyat (2016), who claimed that there is no significant impact of solvency expressed through debt ratio on the profitability of banks. The same results were obtained by studies performed by Boyle et al. (2014) and Sari et al. (2016). However, some previous research indicated a decrease in the solvency ratio due to IFRS 16 implementation (Öztürk & Serçemeli, 2016; Todorova & Sokolova, 2019).

An increase in the company's share price has a significant positive impact on profitability. Buzzel et al. (1975) claimed that increasing share price influences positively profit margin, higher quality of products, and decline in costs. All these factors simultaneously increase the company's return on equity. Due to the significant positive impact of the share price on profitability, it can be concluded that IFRS 16 affects agency relationships positively.

Oil prices negatively influence the profitability of airline companies. Fluctuation in oil price decreases firms' profitability almost by 9%. According to IATA airlines magazine (iata.org), jet fuel prices were stable in the early 2010s, and started to grow from the end of 2016 from $40 per barrel, reaching $95 per barrel in 2018. Consequently, increases in jet fuel prices negatively affect the profitability of airline companies.

The government effectiveness index negatively influences companies' profitability. This index includes such indicators as the level of corruption, efficiency of public services, credibility of government qualities, and others. According to Yanikkaya and Turan (Turan & Yanıkkaya, 2020), a higher government effectiveness rate leads to increased tax and economic growth. As a result, companies, which are main tax donators, pay more taxes and other payments to the budget.

Gross domestic product negatively affects the profitability of airline companies by 2.84%. This finding is supported by the research of Alharbi (2017), who claimed that an increase in GDP negatively influences the profitability of companies. Another explanation could be that in the case of economic growth and development more companies are entering the market, so, as a result, competition increases and consequently their profitability and market share could decrease.

A dummy variable was used to distinguish between years without IFRS 16 effect and the year 2019 when the standards were implemented. From the table above, it is seen that implementation of IFRS 16 reduces companies' return on equity by 23.9%. According to Bugshan et al. (2019), oil price fluctuations negatively affect the profitability of the company. From October 2018 to January 2019, crude oil prices decreased from $74 to $42 per barrel. Additionally, the average oil price in 2019 was 10% lower than in 2018. Moreover, the year 2019 is denoted as the year when the COVID-19 global pandemic began. Consequently, all these global factors could affect the profitability of airline companies in 2019. According to Bouwer et al. (2021), the pandemic's effect on the aviation industry was overwhelming and airline companies would not return to pre-pandemic profitability figures before 2024.

Some researchers show a rise in profitability ratios due to IFRS 16 application (Stancheva-Todorova & Velinova-Sokolova, 2019; Boyle et al., 2014; Öztürk & Serçemeli, 2016; Diaz & Ramirez, 2018).

Returning to enter dummy, which represents figures of property, plant, and equipment in 2019, after implementation of standard and appearance of the right-of-use asset, it increases firms' profitability by 1.61%. This figure illustrates the IFRS 16 Leases application on financial statements. As it was mentioned, under IFRS 16, companies should capitalize all leases except for leases of low value and short-term leases. The interdummy value was computed as dummy variables, which were equal to 1 in the year 2019 or 0 in all other years, multiplied by the value of property, plant, and equipment. Consequently, the amount received represents the effect of the IFRS 16 application on the fixed assets of the company and demonstrates the impact of the standard on the profitability of airline companies.

From the point of agency theory, IAS 17 creates more agency problems since the financial statements, which are tools of agency issues, do not reflect the best presentation of financial elements. Consequently, IFRS 16, which requires capitalization of almost all leases, contributes to the reduction of agency problems (Table 9).

Table 9 Robust check

Robust check	R SQR	52%			
ROE	Coef. Std.	Err.	z	P > z	[95%Conf. Interval]
LNCAR	21.07118	2.307,829	9.13	**0.0000**[c]	16.54792 25.59445
LNFIX	6.975,711	1.020502	6.84	**0.0000**[c]	4.975564 8.975857
SOLV	−0.1,698,517	0.2,134,786	−0.8	**0.4260**	−0.5882622 0.2485587
LNPRICE	3.446,881	0.90,848	3.79	**0.0000**[c]	1.666293 5.227469
OILPRICECHANGE	−8.90,088	4.035804	−2.21	**0.0270**[b]	−17.80,176
GOVEX	−10.86,387	3.495,246	−3.11	**0.0020**[b]	−21.72,775
LGDP	−2.84,087	0.4,837,561	−5.87	**0.0000**[c]	−5.681,739
INTERDUMMY	1.619,233	0.9,121,335	1.78	**0.0760**[a]	−0.1685163 3.406981
DUM	−23.90,879	11.25,836	−2.12	**0.0340**[b]	−47.81,759
_cons	−55.55	15.8832	−3.5	**0.0000**[c]	−111.1

[a]Statistical significance at the 10% level
[b]Statistical significance at the 5% level
[c]Statistical significance at the 1% level

Additionally, a robust regression technique was implemented to achieve more reliable estimates. The Hausman test performed indicates that a random effect model should be implemented, which was used for robust check. As it can be seen from the table above, p-values for current assets, fixed assets, share price, and GDP still are 0 and influence profitability significantly. P-value of oil price change increased from 0.5% to 2.7% and remains significant. The government effectiveness index significance level increased slightly from 0 to 0.2%. Dummy and interdummy p-values changed from 0.02% and 0.07% to 3.4% and 7.6%, respectively. These changes are perceptible; however, they are still significant. The only independent variable which increased strength is the solvency ratio. It has shown an increase from 3.9% to 42.6%. So, its influence on the profitability of airline companies appears to be insignificant. It is important to mention that in case all independent variables do not change, the overall profitability of companies decreases by 55.55%.

Conclusion

IAS 17, a previously effective standard for leases, was replaced by IFRS 16 in 2019. IAS 17 was often criticized by financial statement users for off-balance sheet reporting resulting from the classification of leases. Elimination of operating leases definition is counted as a fundamental change in accounting for leases which allow users to receive more transparent and comparable financial data.

This research aimed to investigate the influence of the new standard IFRS 16 Leases application on the profitability of companies in the airline industry. Moreover, it provides a detailed description of the previously effective standard IAS 17 and the new IFRS 16 standard and their comparison.

The findings support the goal of the International Accounting Standards Board to improve the transparency of financial statements and provide the users of financial statements with more credible and comparative financial information and figures. The results of the study indicate that off-balance sheet leases capitalization due to IFRS 16 provides more relevant information than IAS 17.

Due to the analysis performed, it can be concluded that there are internal figures and macroeconomic factors that influence the profitability of airline companies after the application of new leases standard. Specifically, the number of current assets, property, plant, and equipment have a positive significant influence on airline companies' profitability. As it was expected, the solvency ratio has an insignificant impact on return on equity. Additionally, the positive significant impact of the share price on the company's profitability was revealed. The results indicate that in 2019, there was a decrease in profitability of the firms. However, it is suggested that such numbers were obtained due to global macroeconomic factors such as COVID-19 pandemics or severe oil price fluctuations that influence the world economy and specifically the airline industry.

Some limitations should be considered to interpret the results of the study. First of all, the paper investigates the impact of IFRS 16 based on the right-of-use asset

that is shown in the property, plant, and equipment line. However, as the literature review states the new standard has a significant influence on many elements of financial statements such as liabilities, earnings before interest and tax, depreciation, cash flows, and disclosures. Additionally, the study includes only the first year after the implementation of the standard – 2019. Further studies may contribute to more detailed information.

Future research can investigate the impact of standard on lessor's financial statements. Moreover, other studies may cover additional firm-specific and macroeconomic variables. The new standard eliminated problem of off-balance sheet reporting and meets the needs of bigger quantity of financial statements users. Overall, IFRS 16 Leases enhances the transparency, credibility, and comparability of financial statements and contributes to reflection of a more complete picture of firms' financials.

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Predicting Cryptocurrency Price Returns by Using Deep Learning Model of Technical Analysis Indicators

Negar Fazlollahi and Saeed Ebrahimijam

Abstract Over the last few years, cryptocurrencies have become a new alternative exchange currency for the global economy. Due to the high volatility in the prices of cryptocurrencies, forecasting the price movements is considered a very complicated challenge in the world of finance. Technical analysis indicators are one of the prediction tools which are widely used by analysts. These indicators, which are explored from the historical prices and volumes, might have useful information on price dynamics in the market. Meanwhile, with the new advances in artificial intelligence techniques, like long short-term memory (LSTM), which is able to keep the track of long-term dependencies; there is the extensive application of deep neural networks for predicting nonstationary and nonlinear time series. This study provides a forecasting method for cryptocurrencies by applying an LSTM multi-input neural network to investigate the prediction power of the lags of technical analysis indicators as the inputs to forecast the price returns of the three cryptocurrencies; Bitcoin(BTC), Ethereum (ETH), and Ripple (XRP) that have the highest market capitalization. The results illustrate that the proposed method helps the investors to make more reliable decisions by significantly improving the prediction accuracy against the random walk over the maximum trading time of BTC, ETH, and XRP datasets.

Keywords Cryptocurrency · Deep learning model · Random walk

Introduction

The fast pace of growth in information technology has considerably influenced many sectors; including finance, making the digitalization of financial products and processes more common. Nowadays, cryptocurrencies, as one of the digitalizations

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in finance, are quite widespread. (Dwyer, 2015). These currencies are a new electronic alternative exchange currency method that owns online transactions and is designed based on digital cryptography algorithms. (Ferdiansyah et al., 2019).

Currently, trading in cryptocurrencies is quite predominant, owning the market similar to the stock market. However, due to its high volatility, there is a need for a forecasting method for investors to help them make better decisions in their trading investments (Radityo et al., 2017).

Bitcoin, which was developed in 2009, is the most prominent digital currency today. Each bitcoin has an address and a transaction takes place by trading the bitcoins from one address to another. (Dwyer, 2015). This record is called the "block chain," which is the chain of records of transactions in the form of blocks with each of the blocks having its specific key. A block encompasses cryptographically encoded data locked by its key and the data of the prior block, the entire chain of blocks is created in this regard (Tanwar et al., 2021).

Many cryptocurrencies made their appearance in the crypto market after Bitcoin; Ethereum, and Ripple are among them that draw the attention of many investors. Ethereum developed in 2015, with a market capitalization of $410 billion, and became the second largest cryptocurrency (Tanwar et al., 2021).

In general, cryptocurrency trade is considered one of the most outstanding kinds of profitable investments which comes with its pros and cons. The distinctive characteristic of cryptocurrency is fluctuations in price and high volatility on a regular basis. This characteristic makes their forecasting of them quite challenging.

Nowadays, a different variation of Artificial Neural Network is used to compute the crypto market prediction. In this study, we applied one of the new advances in artificial intelligence techniques, called Long Short Term Memory (LSTM), which is capable of tracking long-run dependencies, and also has the extensive application of deep neural systems to forecast nonstationary and nonlinear time series.

Besides, the study gets the help of technical analysis indicators, which are remarkable forecasting tools. These indicators, through exploring the historical prices and volumes, deliver useful insight and information on price dynamics in the market. More specifically, we incorporate four technical analysis indicators. The adoption of technical analysis is a great concern for both individual and institutional investors, as well as portfolio managers in asset allocation and risk management (Ma et al., 2020).

The objective of this research is to examine a forecasting method for cryptocurrencies by applying the LSTM multi-input neural network to investigate the prediction power of the lags of technical analysis indicators as the inputs to predict the price returns of the three cryptocurrencies, Bitcoin (BTC), Ethereum (ETH), and Ripple (XRP), that have the highest market capitalization. In other words, in this work, we investigate the prediction power of the changes of the lags of technical analysis indicators as the inputs to project the price returns of the mentioned cryptocurrencies, by applying the LSTM multi-input neural network method.

The remainder of the study is structured in this way: in the second part, we present a review of the literature. The data and methodology are illustrated in the third and fourth parts. Empirical results are discussed in part five. And section six drives the conclusion.

Literature Review

There are enormous previous studies that applied technical analysis indicators to predict stock price movements and directions. Among them, de Souza et al. (2018) use technical analysis of the stock price movements of BRICS countries. And Chen et al. (2018) created a new technical analysis dynamic that helps investors decide on a more profitable way. Also, Kuang et al. (2014) examine the technical analysis of profitability in the emerging foreign exchange market of ten countries. In this study, we use four technical analysis indicators as input to our model.

Regarding the usage of deep learning methods for forecasting cryptocurrency price and directional movements, there are various valuable previous works that, in this section, we will briefly present here.

Derbentsev et al. (2020) explored different short-term forecasting models (binary autoregressive tree [BART], random forecast [RF], multilayer perceptron [MLP]) for cryptocurrency prices. They examined Bitcoin, Ethereum, and Ripple (due to their high market capitalization) from August 2015 to December 2019 with 1583 observations. Their outcomes exhibited that BART and MLP models have 63% efficiency in forecasting directional movements, which were higher than the "naive" model.

Livieris et al. (2020) combined three joint learning approaches – ensemble-averaging, bagging, and stacking – alongside the advanced deep learning methods for forecasting cryptocurrency prices of Bitcoin, Ethereum, and Ripple from January 2018 to August 2019. Their results illustrated that their model can be reliable and strong in forecasting.

Patel et al. (2020) applied GRU-based hybrid and LSTM for predicting cryptocurrency prices of Litecoin and Monero from January 2015 to February 2019; they incorporated the average, open, and close prices, also high and low prices as well as trading volume. The result of their study explicated that their model outperforms the traditional LSTM model.

Li et al. (2019) used the multiple input LSTM-based forecasting model and the Black-Scholes (BS) method to predict the prices of bitcoin. They concluded that Blockchain statistics significantly impact their proposed forecasting model.

Wu et al. (2018) applied two LSTM models (conventional LSTM and LSTM with AR[2]) to predict the daily prices of Bitcoin from January to July 2018. Their results explicated the best forecasting accuracy of the proposed model with AR(2).

Most of the previous research applied complex models and methods to attain a better prediction of the price of the cryptocurrency. In this research, we propose a different approach for the development of reliable forecasting; we use the technical analysis indicators as inputs to our model and employ training data with a special architectural design. Notably, we propose an LSTM multi-input neural network model, with the changes in the lag of four technical analysis indicators as inputs exploring the past 14 days of data, in order to predict the direction of next-day prices of cryptocurrencies. As far as we reviewed previous literature, this is the first study

that brought focus on the technical analysis as input to exhibit a more accurate prediction of cryptocurrencies.

Data

Price Returns

The collected data is the daily close prices of Bitcoin (BTC), Ethereum (ETH), and Ripple (XRP) from the yahoo finance database. The objective behind selecting these cryptocurrencies among others is that they possess the highest market capitalization. BTC data covered the period of 2014 to 2022 with 2778 observations. ETH data comprised the period of 2017 to 2022, having 1626 observations. And XPR data encompassed the period of 2017 to 2022, owning 1626 observations. We then convert the prices into returns. The study incorporates all of the available data.

$$\text{Price return} = \frac{Closing\ price_t - Closing\ price_{t-1}}{Closing\ price_{t-1.}}$$

where closing price is the final share price at the end of the daily trading, t is time as of today, and $t - 1$ is yesterday

The below graphs illustrate the price returns of bitcoin, Ethereum, and ripple (Fig. 1).

The data used as the input to our model is the changes in the lags of four technical analysis indicators in order to predict the next day's cryptocurrency price returns.

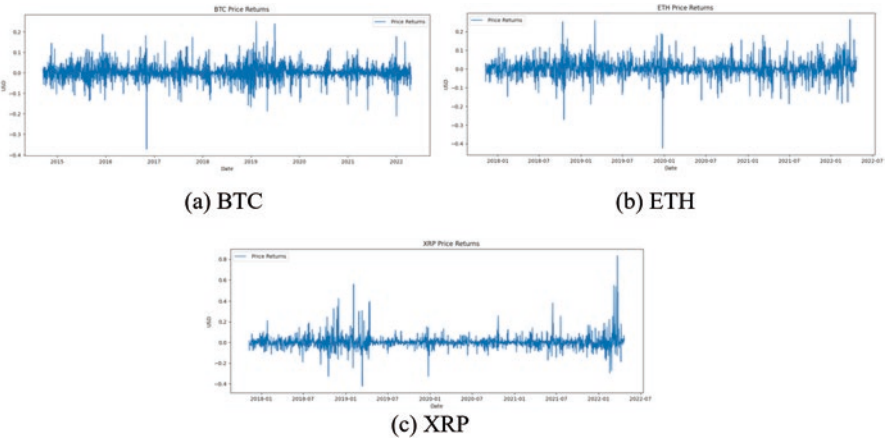


Fig. 1 Price returns of BTC, ETH, XRP

Technical Analysis Indicators

Technical analysis indicators use the price and volume of the shares; they are not based on the profit and earnings of the firm, rather they predict future price patterns by previous historical prices and trends. These indicators serve as the prediction of short-term price movement for active stock traders and benefit long-term investors to predict buy and sell periods.

In this research, regarding the independent variables, the various lags of four technical analysis indicators are used in our structural regression model. These indicators measure the velocity and the magnitude of directional price changes, buyer's enthusiasm trend, the tendency of a closing price compared to the high and low price range, and demand and supply volumes. (Brock & De Lima, 1996; Pathirawasam, 2011) (Table 1).

RSI (Relative Strength Indicator) is used as a criterion for measuring the velocity and the magnitude of directional price changes (Wilder, 1978) (see Eq. [1]). In Eq. (1) $\overline{\Delta P_i^+}$ and $\overline{\Delta P_i^-}$ are average positive (+) and negative (−) price change, respectively, during the last n minutes ago. According to Wilder (1978), the best-assigned n is 14.

$$RSI\left(n\right) = 100 - \frac{100}{1 + \frac{\sum_{i=1}^{n} \overline{\Delta P_i^+}}{\sum_{i=1}^{n} \overline{\Delta P_i^-}}} \tag{1}$$

MFI (money flow indicator) refers to the forecasting reliability of the buyer's enthusiasm trend. It is an indicator of money flowing "into" or "out of" an asset; however, the expression only refers to the forecasting reliability of the buyer enthusiasm trend (see Eqs. [2] and [3]). Obviously, there is never any net money in or out; for every buyer, there is a seller of the same amount (Kirkpatrick II & Dahlquist, 2010).

$$MFI_t = 100 - \frac{100}{1 + \frac{Positive money\ flow_t}{Negative money\ flow_t}} \tag{2}$$

$$Money\ flow_t = \frac{price_t^{high} + price_t^{low} + price_t^{close}}{3} \times volume_t \tag{3}$$

Table 1 List of four technical indicators

RSI	MFI	STOCH	OBV

STOCH (Stochastic Indicator) investigates the tendency of changes in the closing price in comparison to the high and low price variety throughout a particular span (Lane, 2007) (see Eq. [4]).

$$\text{STOCH} = \frac{Pricecloselast - Pricelowest}{PriceHighest - PriceLowest} \times 100 \tag{4}$$

OBV (on balanced volume) OBV measures demand and supply volumes by assessing the trading volumes (V_t). The change in OBV is considered a factor in the decision-making process by market analysts (Granville, 1976) (see Eq. [5]). It shows the movement of volume resulting from the closing price ($price_t^{close}$) changes (Blume et al., 1994).

$$OBV_t = OBV_{t-1} + \begin{cases} V_t & if \quad price_t^{close} > price_{t-1}^{close} \\ 0 & if \quad price_t^{close} = price_{t-1}^{close} \\ -V_t & if \quad price_t^{close} < price_{t-1}^{close} \end{cases} \tag{5}$$

Descriptive Statistics

The results of descriptive statistics of the four technical indicators in terms of mean, standard deviation, skewness coefficients, kurtosis coefficients for the BTC, ETH, and XRP series are reported in Table 2. The results show that over the periods of study, the OBV indicator performs better in terms of average returns in all of the series with a mean of 56. 54, and 69, respectively. Also, the results in terms of medium indicate a higher OBV in all of the series. The standard deviation results do not differ significantly for RSI, MFI, STOCH, and OBV in all of the series.

Normalizing the Data

The ranges of the statistical inputs are quite different; hence, it is necessary to standardize the dataset in a close range to create a faster teaching model. The study applied a z-score to alter data, which is the zero mean and standard deviation of the data.

$$Z = \frac{(x - \mu)}{\sigma} \tag{6}$$

Table 2 Descriptive statistics

BTC					
Variables	RSI	MFI	STOCH	OBV	Close Price ($)
Minimum	9.9	5.8	0.0	−332807330	178.10
Maximum	94.3	96.7	100.0	2687294800000	67566.83
Mean	53.6	54.2	55.4	567362797151	12154.47
Median	52.7	54.4	56.4	170575770000	6475.25
Std. Dev.	14.1	16.8	30.0	751280313788	16623.74
Skewness	0.2	0.0	−0.1	1.17	1.66
Kurtosis	−0.2	−0.5	−1.3	−0.14	1.46
ETH					
Minimum	15.7	0.0	0.0	−39702434000	84.31
Maximum	90.3	94.6	100.0	1789614200000	4812.09
Mean	51.5	53.0	52.7	547318359658	1079.15
Median	50.9	52.2	51.6	161411270000	396.41
Std. Dev.	14.1	17.2	30.1	651499246173	1259.29
Skewness	0.1	0.1	0.0	0.75	1.27
Kurtosis	−0.3	−0.5	−1.3	−1.16	0.23
XRP					
Minimum	19.7	4.8	0.0	−-18672759000	0.139635
Maximum	93.5	96.9	100.0	264690070000	3.37781
Mean	48.7	49.0	44.4	69800103644	0.544315
Median	47.0	47.7	40.7	23107291000	0.408472
Std. Dev.	13.0	17.5	27.2	81490070915	0.386363
Skewness	0.7	0.3	0.3	0.99	2.142296
Kurtosis	0.5	−0.3	−1.1	−0.75	7.907054

Note: Std. Dev. stands for Standard Deviation

Methodology

The Architectural Design of the Proposed Model

The proposed model is LSTM multi-input neural network model, which is not processing all the data simultaneously, instead, each data is processed and handed independently, then the processed data are merged and further utilized for estimating the final prediction. The aim of this method is to independently extract useful information from various datasets. The advantage of using this model is providing more flexibility and adaptivity for low computation efforts.

The architecture of the utilized Neural Networks is a four-layer LSTM with two fully connected (dense) layers applied, Leaky ReLU and Sigmoid Activation functions, respectively. Its loss function is the mean squared error with "ADagrad" optimizer algorithm. This study used 75% samples to train our LSTM multi-input neural network model and then validated it on 25% samples (under 50 epches and 56 batch size) (Fig. 2).

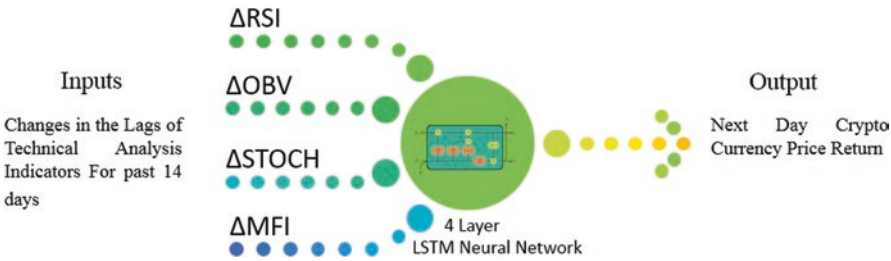


Fig. 2 The overview architecture of the proposed model

#1	Training (2014-2022), 2083 train 75%	Testing 695 test
#2	Training (2017-2022), 1219 train 75%	Testing 407 test
#3	Training (2017-2022), 1219 train 75%	Testing 407 test

Fig. 3 Training and testing process

Training and Testing Process

To generate and then assess our model, we require to train and test the datasets. Also, we need to evade the problem of overfitting results by dividing time series data into numerous portions by adopting a sliding window over time.

We adopt three datasets (#1, 2, and 3) to have "three-fold cross-validation". We train 75% of the whole dataset (75% training was selected in order to avoid the problem of overfitting), and test the remaining 25%. In the graph below, the training and testing approach is illustrated. #1 shows the results of BTC, #2 depicts ETH, and #3 portrays XRP (Fig. 3).

Performance Evaluation

Predicting the direction of the changes is very important, especially for trend trackers (Bai et al., 2015). Many trend-following trading techniques use the probability of trend direction in high-frequency timespans (Rechenthin & Street, 2013). As shown in the equation, we use a percentage of correct direction change prediction (%CDCP), which gives the proportion of correctly forecast directional changes given lead time *s* (during the whole forecasting period).

$$\%\text{correct direction change prediction} = \frac{1}{T-(T_l-1)}\sum_{T}^{t=T_l} Z_{t+s} \tag{7}$$

Where Z_{t+s}'s are binary expressions come from below equations, y_t and y_{t+s} are realized values and f_{t+s} are the forecast values.

$$Z_{t+s} = 1 \text{ if } (y_{t+s} - y_t)(f_{t+s} - y_t) > 0$$

$$Z_{t+s} = 0 \text{ otherwise}$$

These two measures help us to estimate the predicting efficiency of the proposed synergistic model relative to both stand-alone methods, namely, the technical analysis structural model and the intra-market model.

Empirical Results

By applying the mentioned LSTM neural network model, after training 75% of sample data, 25% of the test sample for BTC, ETH, and XRP price returns are predicted as presented in Fig. 4.

Table 3 presents the statistical analysis performed by CDCP, MAE, and RMSE. More specifically, Table 3 provides statistical evidence that our proposed model can predict 63% correct directional changes of price for BTC. Meanwhile, 74% correct prediction of directional changes of the price of ETH. Finally, our model is able to forecast 77% of directional changes in the price of XRP.

MAE and RMSE, which are more popular in financial forecasting studies, have been also applied in our study (Draxler & Siebenhofer, 2014; Chortareas et al., 2011; Lahmiri, 2014).

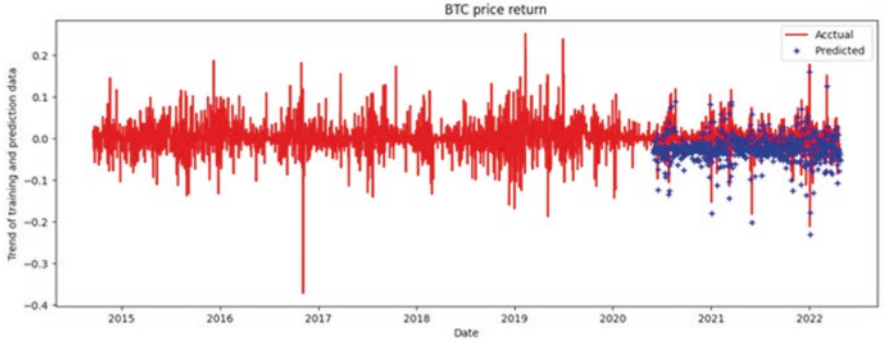
We also compare the predicting performance to the random walk benchmark method. The random walk model implies that future price changes are not predictable. Historical memory is not useful; it is just a series of random numbers (Fama, 1965).

The result of the percentage of correct direction change prediction (%CDCP) should be greater than 50% in order to validate the superior performance of the proposed model in comparison with the random walk model (Hong et al., 2007).

The critical value at a 1% statistical significance level can be approximated for the random walk model by the following equation (Cai & Zhang, 2016):

$$\sigma_{0.01\%} = \frac{\sim 3.719016}{2\sqrt{n}} \tag{8}$$

where *n* is the number of predictions, and ½ comes from the equal probability of having positive and negative change. In our case, due to the different number of



(a) BTC

(b) ETH

(c) XRP

Fig. 4 Daily price returns of cryptocurrencies BTC, ETH, XRP

observations, the critical values ($\sigma_{0.01\%}$) would be 0.03 and 0.04 for 2778 and 1626 observations, respectively.

In order to check the significance of the obtained forecasting results, according to *CDCP-50%* values in Table 3, all the values 0.13, 0.24, and 0.27 are greater than the critical values 0.03, 0.04, and 0.04, respectively, which means that all the obtained forecasting results are statistically significant.

Table 3 The CDCP, MAE, and RMSE of BTC, ETH, and XRP

Cryptocurrency	CDCP	CDCP-50%	Critical value at 1% ($\sigma_{0.01\%}$)	MAE (train period)	RMSE (test period)
BTC	63%	0.13	0.03	0.0756	0.05
ETH	74%	0.24	0.04	0.1223	0.09
XRP	77%	0.27	0.04	0.1413	0.20

Conclusion

The study proposed a deep neural network method constructed by a multi-input architecture in order to forecast the next day's cryptocurrency prices.

The proposed forecasting model gets the benefit of different lags of four technical analysis indicators as inputs, which examine them separately in order to exploit and process each data independently.

Particularly, every technical analysis indicator's data contains inputs to various convolutional and LSTM layers, which are employed for learning the internal demonstration and determining the short-run and long-run dependencies of each cryptocurrency, respectively.

Subsequently, the model combines the refined data captured from the output vectors of LSTM layers and additionally develops them to create the final forecasting. It is worth mentioning that all of the applied cryptocurrency time series were transformed according to returns transformation so as to capture the stationarity characteristics and to be proper for fitting the proposed model.

We use three cryptocurrencies with the highest market capitalization, i.e., Bitcoin, Ethereum, and Ripple. The detailed experimental analysis illustrated that the proposed model has the ability to provide significant price movement forecasting, outperforming the traditional deep learning models with more precise price prediction.

More specifically, we reached 65% significate price prediction for bitcoin, and 74% significate price prediction for ETH, finally, 77% significate price prediction for XRP.

The results illustrate that the proposed method helps the investors to make more reliable decisions by significantly improving the prediction accuracy against the random walk over the maximum trading time of BTC, ETH, and XRP datasets.

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What Factors Affect the Profitability Determinants of Commercial Banks in the MENA Region?

Vladibslav Pan, Dariya Ainekova, and Alimshan Faizulayev

Abstract The aim of the work empirically investigates financial performance determinants. We use the ordinary least squares method to run a regression of bank profitability on bank-specific and macroeconomic variables using panel data. We collected data from World Bank Databases and Orbis Bank Focus for the period of 2005–2017 in MENA regions. The findings show that bank-specific variables explain profitability substantially more than macroeconomic variables.

Keywords Banking profitability · Government stability · GDP · Unemployment

Introduction

The bank is a financial institute that is included in borrowing and lending money. Banks should be able to absorb losses and fulfill their payment responsibilities. Safe and effective must be the banks' payment systems. Banks play an important role in the development of a country. Banks provide funds for the business.

According to World Atlas, MENA countries possess 45% of the world's natural gas resources, 60% of the world's oil resources, and 6% of the population in the world. MENA is an important wellspring of resources due to significant petrol and natural gas reserves. MENA countries are the Middle East and North African countries.

Many researchers studied profitableness in Europe, but few people only analyzed some aspects of profitableness in the MENA countries. Olson and Zoubi (2011) note that countries observed a quick rise in terms of populace and welfare. The MENA countries represent a bridgework betwixt Asia and Europe.

The goal of my work is to determine the profitability determinants by using bank-specific and macroeconomic variables.

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After decades of novation, on the verge of a financial market crash, the banking sector flourished. The working conditions of the banking sector have changed market developments. Framework and efficiency influence external and internal factors, which is why a basic overestimation of the banking sector is required (Rosenthal, 2011). Assessment of bank working is important for all parties: bank managers, investors, and regulators. Bank performance provides a signal to bank managers whether to develop its loan service or deposit service or both to promote its finance.

Literature Review

Profitability Determinants Review

Faizulayev et al. (2021) empirically investigated the profitability determinants of the banking industry in CIS countries between 1991 and 2017. To do the regression analysis, they employed a feasible generalized least square (FGLS) method. They found that some of the bank-specific variables influence positively the profits of the banks in the CIS countries. But, macroeconomic variables negatively affect profitability. However, political stability has no impact on the financial performance of these banks.

Curak et al. (2012) researched industry-specific, bank-specific, macroeconomic determinants of bank profitability. In the banking system of Macedonia, a dynamic panel analysis was used on a sample of 16 banks from 2005 to 2010. The most important internal factor of the bank is operating expense management. The Republic of Macedonia indicates the result in bank profitability such external variables as economic growth, banking system reform, and concentration.

Faizulayev et al. (2020) researched the effects of bank-specific and macroeconomic variables on the financial performance of conventional banks operating in newly classified countries over the period of 1997 to 2017. To do the regression analysis, they employed the OLS method. The results indicate that bank-specific and macroeconomic variables are very crucial in explaining profitability.

Athanasoglou et al. (2008) researched the impact of industry-specific, bank-specific, macroeconomic determinants of bank profitableness, using an empirical basis. They employ a GMM technique in a panel of Greek banks between 1985 and 2001. The outcomes illustrate that profitability continues to a moderate stage, illustrating that departures from perfectly competitive market structures may not be that large.

Şamiloğlu (2017) researched the determinants of firms' financial performance indicators (ROA, ROE). They used financial ratios of selected 51 firms quoted at the Istanbul Stock Exchange (BIST) between 2006 and 2015. There is a considerable and negative relationship between ROA and the Price-to-Earnings (PE) ratio.

Bank Specific Variables

Size: Log of Total Assets basically refers to economies of scale (Athanasoglou et al., 2008).

Larger banks have more ability to use the advantages of scale efficiency in transactions which results in higher profits. Large banks can influence market power through a stronger brand image or implicit regulatory protection. A positive relationship might be expected between the bank's size and its profitability (Kosmidou, 2008).

Liquidity: Liquidity risk shows the disability of a bank to perform its obligations which can eventually lead to bank failure. The ratio of loans to deposits is usually measured as exposure to liquidity risk. The bank holds a higher amount of liquid assets which can be easily converted to cash to decrease the insolvency problems. Lower rates of return usually have liquid assets. Lower profitability would mean higher liquidity (Kosmidou, 2008).

Asset quality: Credit risk as the quality of bank assets can be measured using loan loss allowances according to some authors (e.g., Kosmidou, 2008). Profitability will be negatively impacted by higher provisions, as provisions exhibit higher risk and a higher likelihood of loans becoming non-performing. (Kosmidou, 2008).

Management efficiency: Management Efficiency is another important variable that determines banking profitability. Management Efficiency is usually measured by the quotient of operational costs to assets (Athanasoglou et al., 2008). Rationale assumes a minus relationship because improved management of operating expenses improves efficiency and eventually leads to higher profits. External determinants relate to those that furnish macroeconomic characteristics and industry. Previous studies (e.g., Pervan et al. 2010) have aimed to control industry externalities.

Macroeconomic Variables

Government stability: The survey by Yahya et al. [2017] indicates that the profitability of Islamic banks in Yemen has a decisive influence on political stability. Political instability had a plus influence on the profitability of Islamic banks between 2010 and 2014.

Inflation: the positive impact of inflation on profitability attributed to accurate prediction of future inflation, where banks increase their margins with expected inflations. Inflationary periods are usually accompanied by higher GDP rise, which enables banks to have higher profits. (Athanasoglou et al., 2008).

Scale Efficiency Theory

Scale efficiency theory says the more services a company produces, the more efficient the company becomes. Scale efficiency is the capacity of every firm to act as closely as possible to its most productive scale size, with an inability to do so resulting in a growth in average costs.

Data and Methodology

Data: The investigation includes panel data statistics of banks in MENA regions. The period of the analysis is considered between 2005 and 2017 for all the variables. We use government stability and inflation from the World Bank database, but other variables we use from Orbis Bank focus.

Table 1 consists of the symbol, the empirical evidence, and the information on the proxy of measurements.

Methodology

Hypothesis 1: The size of banks (LTA) has a negatory/affirmative influence on profitability.

Hypothesis 2: The asset quality of banks (NPL) has a negatory/affirmative influence on profitability.

Hypothesis 3: The management efficiency of banks (LTA) has a negatory/affirmative influence on profitability

Table 1 Variables Description

Symbol	Variables	proxy	Researchers
Dependent variables			
ROA	Return on assets	Return on assets = net income/Total assets	Faizulayev et.al [2].; Perera et al. [5]
Independent variables			
LIQ	Liquidity ratio	Liquid assets/total assets (%)	Dietrich and Wanzeneried [17]; Faizulayev et al. [2]
NPL	Credit risk	Non-performing loans to gross loans (%)	Titko et al. [10]
INFL	Inflation	Consumer price index	Riaz and Mehar [6]
GS	Government stability	The rank of government stability (world competitiveness report)	Yathya et al. [1]
CTI	Management efficiency	Cost to income	Munyambonera [10]
LTA	Log of Total Assets	Just taken Log of total assets	Athanasoglou et al. [6]

Table 2 List of banks

No. of bank	Bank
1	*Al Rajhi Bank- Saudi Arabia*
2	*Bankque Saudi Fransi- Saudi Arabia*
3	*Arab National Bank- Saudi Arabia*
4	*Bank AlJazira- Squdi Arabia*
5	*Riyad Bank- Saudi Arabia*
6	*Samba Financial Group- Saudi Arabia*
7	*The Saudi British BK.- Saudi Arabia*
8	*The Saudi Investment BK.- Saudi Arabia*
9	*Commercial Bk. Of Qatar - Qatar*
10	*Doha Bank - Qatar*

Hypothesis 4: The liquidity of banks (LIQ) has a negatory/affirmative influence on profitability.

Hypothesis 5: The inflation of banks (INFL) has a negatory/affirmative influence on profitability.

Hypothesis 6: The government stability of banks (GS) has a negatory/affirmative influence on profitability.

Methodology: The target of this exploration is an experiential analysis of the influence of bank-specific, macroeconomic, and government stability variables on the banks' financial performance in MENA (the Middle East/North Africa) countries.

For experiential analysis of the variables, we employ the Ordinary Least Square method.

Our regression model is as follows:

$$\mathrm{Yit} = \mathrm{B0} + \mathrm{B1}^{*}\,\mathrm{LTAit} + +\mathrm{b2LIQit} + \mathrm{b3NPLit} + \mathrm{b4INFLnt} + \mathrm{b5CIit} + \mathrm{b6GSnt} + \mathrm{b7}^{*}\,\mathrm{t} + \mathrm{e}$$

$$\mathrm{Yit} = \mathrm{B0} + \mathrm{B1}^{*}\,\mathrm{LTAit} + +\mathrm{b2LIQit} + \mathrm{b3NPLit} + \mathrm{b5CIit} + \mathrm{b6}^{*}\,\mathrm{n}\left(\text{nation fixed effect}\right) + \mathrm{b7}^{*}\,\mathrm{t} + \mathrm{e}$$

Y introduces the dependent variable, β introduces the coefficients, and β0 and ε introduce constant terms and error terms, respectively (Table 2).

Empirical Results (Table 3)

As we can see from Table 1, descriptive statistics, on average ROA, which is the profitability ratio, is 0.023612. Whereas the size is proxied as LTA, from the same table we can see that on average LTA is 17.11692. Furthermore, on average NPL is

Table 3 Descriptive statistics on banks of MENA region

Variable	Obs	Mean	Std. Dev.	Min	Max
ROA	130	.023612	.0144621	.0008757	.1256264
LTA	130	17.11692	.6927074	15.14472	18.33172
NPL	130	.6910612	.1090262	.0238525	.9074092
CI	129	6.118661	6.758681	1.692076	40.59183
LIQ	130	.0649037	.0365696	.0210855	.2337271
INFL	130	4.763893	12.6027	-24.33841	30.5427
GS	130	9.505128	1.063436	7.75	11.5

Table 4 Correlation matrix on banks of Mena regions

	ROA	LTA	NPL	CI	LIQ	INFL	GS
ROA	1.0000						
LTA	-0.2580	1.0000					
NPL	-0.0727	-0.1707	1.0000				
CI	0.0826	0.5041	0.0492	1.0000			
LIQ	-0.0168	0.0293	-0.1806	0.1087	1.0000		
INFL	0.2858	-0.3095	-0.0195	-0.0772	-0.1795	1.0000	
GS	0.2220	-0.5614	0.1787	-0.2771	0.0046	0.2466	1.0000

0.6910612. Likewise, on average CI is 6.118661. Moreover, on average LIQ is 0.0649037. Furthermore, on average INFL is 4.763893. Moreover, on average government stability is 9.505128 (Table 4).

The correlation between ROA and LTA is negative, 25.80%, and weakly correlated. Furthermore, the correlation between ROA and NPL is negative, 7.27%, and weakly correlated. Likewise, the correlation between ROA and CI is positive, 8.26%, and weakly correlated. Moreover, the correlation between ROA and LIQ is negative, 1.68%, and weakly correlated. Furthermore, the correlation between ROA and INFL is positive, 28.58%, weakly correlated. Likewise, the correlation between ROA and GS is positive, 22.20%, weakly correlated.

The correlation between LTA and NPL is negative, 17.07%, and weakly correlated. Furthermore, the correlation between LTA and CI is positive, 50.41%, with a moderate correlation. Likewise, the correlation between LTA and LIQ is positive, 2.93%, and weakly correlated. Moreover, the correlation between LTA and INFL is negative, 30.95%, and weakly correlated. Likewise, the correlation between LTA and GS is negative, 56.14%, a strong correlation.

The correlation between NPL and CI is positive, 4.92%, and weakly correlated. Furthermore, the correlation between NPL and LIQ is negative, 18.06%, and weakly correlated. Moreover, the correlation between NPL and INFL is negative, 1.95%, and weakly correlated. Likewise, the correlation between NPL and GS is positive, 17.87%, and weakly correlated.

The correlation between CI and LIQ is positive, 10.87%, and weakly correlated. Furthermore, the correlation between CI and INFL is negative, 7.72%, and weakly correlated. Moreover, the correlation between CI and GS is negative, 27.71%, and weakly correlated.

Table 5 Regression analysis of profitability determinants in the MENA region

Source	SS	df	MS	Number of obs	=	129
				F(6, 122)	=	4.91
Model	.004998613	6	.000833102	Prob > F	=	0.0002
Residual	.020700216	122	.000169674	R-squared	=	0.1945
				Adj R-squared	=	0.1549
Total	.025698828	128	.000200772	Root MSE	=	.01303

ROA	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LTA	-.0065304	.0023335	-2.80	0.006	-.0111497	-.001911
NPL	-.0254766	.0132883	-1.92	0.058	-.0517821	.0008289
CI	.0006317	.000204	3.10	0.002	.0002279	.0010355
LIQ	-.0154401	.0331357	-0.47	0.642	-.0810355	.0501553
INFL	.0001933	.0001002	1.93	0.056	-5.01e-06	.0003915
GS	.0015024	.0013204	1.14	0.257	-.0011115	.0041163
_cons	.1348126	.0486679	2.77	0.006	.0384696	.2311557

The correlation between LIQ and INFL is negative, 17.95%, and weakly correlated. Likewise, the correlation between LIQ and GS is positive, 0.46%, and weakly correlated.

The correlation between INFL and GS is positive, 24.66%, and weakly correlated (Table 5).

$$\mathrm{ROA} = 0.1348126\{0.0065304(\mathrm{LTA})\{0.0154401(\mathrm{LIQ})\{0.0254766(\mathrm{NPL}) + 0.0001933(\mathrm{INFL}) + 0.0006317(\mathrm{CI}) + 0.0015024 + \mathrm{E}$$

From the perspective of regression analysis in Table 4, we can see that the majority of the independent variables are statistically significant. LTA has a negative impact on the profitability ratio, which is statistically significant at 1%. With increasing size, banks will face higher costs and then will reduce profitability. It is supported by scale inefficiency theory. Credit risk influences the ROA negatively, and it is statistically significant at 10%. The more bad loans, the yield will fall. CI has a positive impact on the profitability ratio, which is statistically significant at 1%. LIQ influences the ROA negatively, and it is not statistically significant. INFL has a positive influence on the profitability ratio, which is statistically significant at 10%. Inflation is forecast correctly, which has a positive result on profitability. GS influences ROA negatively, it is not statistically significant.

19.45% variations or changes in ROA, can be explained by variations in independent variables. Though two independent variables are not significant, the whole model is best fitted or statistically validated at 1%.

Conclusion

The aim of this work empirically investigates financial performance determinants. We collected data from Orbis Bank Focus and World Bank Databases for the period of 2005–2017 in MENA regions.

LTA has a minus influence on the profitability ratio, which is statistically significant at 1%. Credit risk influences the ROA negatively, and it is statistically significant at 10%. CI has a positive impact on the profitability ratio, which is statistically significant at 1%. LIQ influences the ROA negatively, and it is not statistically significant. INFL has a positive impact on the profitability ratio, which is statistically significant at 10%. GS influences the ROA negatively, and it is not statistically significant.

We recommend banks not to expand because expansion will lead to additional costs. We recommend banks keep management efficiency and inflation forecasts because it improves their profitability. We do not recommend banks lend bad loans because the yield will fall.

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