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Article

The Robustness of the Determinants of Overall Bank Risks in the MENA Region

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Abstract: **Purpose:** The banking sector in the MENA region is exposed to financial risks that originate from both the internal and external environment. Related studies in the literature have reached inconclusive determinants of the overall risks to banks. This paper examines the robustness of the determinants cited in the related literature. **Design/methodology/approach:** This paper examines the country-specific and bank-specific factors that affect banks' Z-score (being a proxy for the overall bank risks) in the MENA region. The sample banks consist of 33 listed commercial banks operating in six countries in the MENA region. Balanced panel data over 20 years (2000 to 2020) was examined, having a total of 660 observations. The Pooled Ordinary Least Square estimation (OLS) was used to carry out the empirical analysis. **Findings:** The findings of this paper showed that the robust determinants of overall bank risks are follows: (a) The unemployment rate had a negative effect on high overall bank risks in the period 2000–2010, (b) The financial crisis had a positive effect on the MENA overall bank risks in the period 2000–2010, but only for the low overall bank risks, (c) A robust and negative effect of cost/income ratio was observed in the period 2010–2020 only for high overall bank risk, (d) Low overall-risk banks were able to manage overall risks in a shorter time than high overall bank risks, and (e) In terms of the country-wide effect, the results for Egypt only showed that the overall bank risk had positive effects in the period 2000–2010, but negative and significant effects in the period 2011–2020 where overall bank risks reduced. **Originality:** This paper offers robust findings in the controversy around the determinants of overall bank risks in the MENA region, which is beneficial in light of the fact that the literature thus far has not reached a consensus regarding this issue.

Keywords: Z-score; bank-specific; country-specific; MENA region; robustness**JEL:** G21

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1. Introduction

The banking sector has a crucial role in the economic system of any country. It is regarded as the hub of economics and finance and an indicator of a country's economic strength or weakness. Banks basically perform a vital role in the economy by acting as fund intermediaries between depositors and creditors. These funds are then redirected to activities that support business and lead to economic growth. Therefore, the effectiveness and soundness of bank management are essential to economic stability for sustainable economic growth (Hossain 2020). According to Ghosh (2017), bank assets make up 60 percent to over 100 percent of GDP across MENA countries. Consequently, the role of commercial banks is especially essential in developing countries, like the MENA region, where the capital market is immature. As a result, commercial banks have become the most commanding financial institutions in the financial system (Yitayaw 2021).

However, the financial industry has experienced financial problems and crises which have led to huge losses and bankruptcy. The reasons for the unusual occurrences of crisis in the banking sector include inadequate risk analysis and poor credit assessment (Hossain 2020). In order to avoid the recurrence of this crisis, regulators, policymakers, and international supervisory authorities have searched for new methods to reach a well-structured risk management system by implementing several measures to reinforce capital and bank liquidity, especially after many financial crises (Abuzarqa 2019).

The MENA region consists of both ends of the spectrum; it ranges from the biggest and wealthiest oil-producing countries to the politically unstable and oil-importing countries. Moreover, the banking system in the MENA region presents some similarities and some differences. Some countries in the MENA region have recorded strong economic growth in the past two decades, while others have been stuck in political conflict and civil war that inhibit their growth. For example, in North African countries, the banking sector is dominated by state-owned banks, and it plays a rather crucial role in the economy as it is recognized as the principal source of funding. Compared to the North African countries, the banking sector in the Gulf Cooperation Council (GCC) region is more stable, more developed, and less exposed to bank risks. Furthermore, the banking sector in the Middle East, in general, is more profitable and more efficient, while the North African banking sector has recorded low profitability, insufficient liquidity, and a high level of NPLs (Abdelaziz et al. 2022).

The MENA region has been chosen for several reasons. First, few studies analyze the determinants of commercial bank risks in the MENA countries. Second, credit growth rates in the MENA countries have been more volatile, which may raise concerns about the financial system's stability, and, in particular, higher credit growth is often followed by financial crisis. Third, the MENA countries attract bankers and investors worldwide. This strategic position exposes the MENA region to political instability and, thus, to economic and financial instability. Fourth, the MENA region faces numerous changes, such as the commercial banks, operating alongside of and competing with their Islamic ones, opening certain markets to foreign competition (Ghenimi et al. 2017). Therefore, the crucial role played by banks in the economies of the MENA region is important to maintain their stability.

As far as the authors' knowledge is concerned, although many studies have used several measurements of different risks, none of them have used the time effect and country effect variables. The time effect reflects the increase or decrease in bank risks over time. The country effect can be applied to cross-cultural studies, indicating that the risk may vary (increasing or decreasing over time) from one country to another. Consequently, the paper fills the gap in the literature by introducing new variables to manage overall risk, which is a prerequisite for managing the banking sector: time effect (duration) and country effect.

1.1. Objectives

Identify the country-specific variables influencing overall bank risks
 Identify the bank-specific variables influencing overall bank risks
 Examine the time effect and country effect on overall bank risks.

1.2. Contribution

This paper contributes to the related studies by offering robust factors that bank management must focus on to improve overall bank risks in the MENA countries examined. This contribution is divided into two levels, namely, bank-specific and country-specific.

1.3. Contributions Related to Bank-Specific Variables

The robust estimates of banks' cost/income ratios offer evidence that banks must focus on cost reduction strategies that help reduce overall bank risks (e.g., increase the value of the Z score). The robust insignificance of banks' ROE offers evidence that the use of banks' ROA in the Z score metric is quite relevant. The new dimension about measuring

the duration of time effect in managing bank risks offers robust evidence that low-risk banks are able to manage overall bank risks in a shorter time than high overall bank risks.

1.4. Contributions Related to Country-Specific Variables

The overall results of the robustness test show evidence that the reduction of unemployment is a critical factor that helps lower bank risks.

The rest of the paper is organized as follows. The first section discusses related studies about the determinants of overall bank risks. The second section describes the data, the variables and statistical estimations. The third section discusses the results. The Fourth section tests the robustness of the results. The fifth section concludes.

2. Literature Review

Overall bank risks: The way to measure bank risks is an important focus for academics and practitioners, especially in a post-crisis period. Traditionally, the most commonly used risk measures taken by financial institutions are VaR (value at risk) and ES (expected short fall). However, the recent financial crisis led to suggestions that these traditional measures have failed to fully capture bank risks, especially downside risk. Therefore, this paper concentrates on bank risk measures using accounting data, with the main focus of Z-score. Li et al. (2017) has stated that Z-score was built on a work by Roy (1952) and was afterwards developed by Boyd and Graham (1986); Hannan and Hanweck (1988); and Boyd et al. (1993).

According to Bouvatier et al. (2018), the Z-score is widely used in empirical banking literature to reflect bank stability. Furthermore, Z-score is one of the indicators used by the World Bank in their global financial development database to measure financial institutions' soundness. Its widespread utilization is due to its relative simplicity in calculation by using only publicly available accounting data. In addition, Köhler (2012) has stated that the Z-score is an overall measure that captures not only liquidity but also credit and market risks.

Despite its popularity in the measurement of bank risk, there are still many unsolved issues for the Z-score. One main question which has not been discussed is how a bank's risk profile might change over time and the consequent relative stability of risk measures. This partially explains the different methods in constructing Z-score in prior literature (Li et al. 2017).

It is worth noting that the authors in the present paper discuss the variables that have been previously examined in the related literature. This is quite convenient, given that the main focus of the paper is to examine the robustness of these variables.

Several studies have examined the factors that affect the overall bank risks (Z-score). Those studies categorized bank risks into microeconomic (bank-specific) and macroeconomic (country-specific) factors. In this review, the authors focus on country-specific variables that have been examined in the related studies. These variables are GDP, inflation, unemployment, and financial crisis. The same is true for bank-specific variables that include bank efficiency, size, profitability, time effect, and country effect.

2.1. Country-Specific Variables

- (1) Gross domestic product (GDP): GDP can have mixed implications for overall bank risks. According to many authors (Hamdi and Hakimi 2019; De-Ramon et al. 2020; Pham et al. 2021), GDP has a positive impact on bank overall risks. This result has suggested that an increase in the level of economic growth increases the level of bank profitability. Thus, banks expand their businesses, which improves their stability, and thus the Z-score increases. However, it can be noted that GDP and overall bank risks can be negatively related (Imbierowicz and Rauch 2014; Ghenimi et al. 2017; Chen 2018; Ghassan and Guendouz 2019; Rahman et al. 2021).
- (2) Inflation. On the one hand, inflation has a negative effect on overall bank risks (Ghassan and Guendouz 2019; De-Ramon et al. 2020; Rahman et al. 2021). These authors have argued that when countries face inflationary pressures, they weaken the

borrowers' repayment capacities, and, thus, the credit risk rises and leads to a rise in the overall risk of the bank, and, thereby, the Z-score decreases. On the other hand, some studies (Ghenimi et al. 2017; Abbas et al. 2021; Soebyakto et al. 2020; Pham et al. 2021) have stated that inflation and Z-score are positively related. Hamdi and Hakimi (2019) have stated that inflation has no significant effect on overall bank risks.

- (3) Unemployment. Dawood et al. (2016) and De-Ramon et al. (2020) have found that unemployment has a significant negative influence on overall bank risks. They have stated that a higher level of unemployment rate reduces the national income, weakening borrowers' repayment capacities and, consequently, increasing the credit risk and, thus, the overall risk resulting in a decrease in the Z-score.
- (4) Financial Crisis. According to Hamzani and Achmad (2018), financial crisis has a negative impact on overall bank risks. This finding was reinforced by the studies of many authors (Imbierowicz and Rauch 2014; Ghenimi et al. 2017; Chen 2018; Hamdi and Hakimi 2019). These authors have stated that financial crisis always hits banks' performance in terms of solvency, liquidity, operating efficiency, and profitability, and, consequently, increases the probability of bankruptcy in banks which drives the Z-score down. However, Beck et al. (2013) has reported that financial crisis has a positive effect on overall bank risks in their investigation of the MENA region. This could be justified by the fact that a higher level of capitalization and liquidity reserves in the MENA countries leads to better stability during international financial crisis. Moreover, another possible explanation is the partial integration of some MENA countries into the global financial system that triggers upward movement in the Z-score.

2.2. Bank-Specific Variables

- (1) Operating Efficiency. Studies in the literature have concluded that operating efficiency has a positive impact on overall bank risks (Imbierowicz and Rauch 2014; Ghenimi et al. 2017; Chen 2018; Ghassan and Guendouz 2019; De-Ramon et al. 2020; Soebyakto et al. 2020; Rahman et al. 2021). These authors have justified their views by arguing that a higher level of operating efficiency implies that the banks have sound management in administrating internal costs. Cost-efficiency results in higher bank stability, which increases the Z-score. In this regard, improvements in operating efficiency strengthen banks' performance and survival in the banking sector, and, thus, the Z-score rises.
- (2) Bank Size. There are two opposing arguments regarding the relation between size and overall bank risks. The "too-big-to-fail" theory states that larger banks are more likely to take on more risk, and, consequently, larger banks have a greater probability of failure. In this context, the bank's size decreases banking stability and Z-score. This theory is reinforced by the findings of many studies (Dawood et al. 2016; Ghenimi et al. 2017; Hamzani and Achmad 2018; Ghassan and Guendouz 2019). However, size and overall bank risks can be positively related (Imbierowicz and Rauch 2014; Pham et al. 2021; Nguyen 2020; Abbas et al. 2021). This implies that the greater the size of a bank indicates that the bank has well-diversified portfolios and is more efficient because of economies of scale, which drives Z-score up and enhances stability.
- (3) Bank Profitability. The effect of profitability on overall bank risks could be positive or negative. From one perspective, results show that profitability and Z-score are positively and significantly related (Ghenimi et al. 2017; Hamdi and Hakimi 2019; Abbas et al. 2021; Pham et al. 2021). The relationship is attributed to the fact that a higher level of profitability means banks have less incentive to invest in risky investments, which drives the Z-score up and, thus, maintains bank stability. Nevertheless, according to Jan and Marimuthu (2015), profitability has a negative impact on overall bank risks. They have demonstrated that a higher level of profit margin encourages banks to invest in risky investments, which lowers Z-score, and, thus, their overall risk increases.

2.3. Data, Variables and Statistical Estimation

Data

This paper examines data about thirty-three commercial banks in the MENA region, covering the period 2000–2020. The countries examined in this paper included Egypt, Qatar, Kuwait, the UAE, Saudi Arabia, and Morocco. The total number of observations was 660. Several countries were excluded due to conditions of civil war and political instability, and others due to the inaccessibility of data. A list of the banks examined in this paper is reported in Table A5 in Appendix A. Bank-level data were obtained from the Bankscope database and the annual reports of each bank. Macroeconomic data were collected from the World Bank Indicators (WDI) database.

2.4. Empirical Model

The Hausman test (Hausman 1978; Hausman and Taylor 1981) was carried out to determine whether the estimation method was to be based on fixed or random effects. The results are reported in Tables A1 and A2 in Appendix A.

The results show that country-specific variables were subject to fixed effects, while bank-specific variables were subject to random effects. The relevant estimation methods were carried out accordingly. Dummy variables were developed to capture the effects of countries' differences.

The panel Least Square estimation was carried out for the panel data using Least Squares Dummy Variables (LSDV) as follows:

$$y_{tk} = \alpha_k + \sum_{i=1}^k \beta_{ik} \chi_{itk} + \lambda_k + v_{tk}$$

where $t = 1, \dots, n$; k = number of banks; y = Z-scores values; Xs = independent variables being classified into two groups, namely, country-specific and bank-specific; λ_k = random error term due to the individual effect; v_{tk} = random error.

2.5. Variables Definitions and Measurement

(1) Dependent Variable

Overall Bank Risks: The Z-score is an overall measure of bank risks. This metric has been examined in various related empirical studies (Hannan and Hanweck 1988; Lepetit and Strobel 2015; Ghenimi et al. 2017; Chen 2018; Hamdi and Hakimi 2019; De-Ramon et al. 2020; Pham et al. 2021).

The rationale of the Z-score metric is that it combines all bank activities that are intrinsically reported in the income statement and balance sheet in terms of bank assets and profitability. The latter have been examined in related studies of bank stability (Lepetit and Strobel 2015) and forward-looking bank risks (Hafeez et al. 2022).

A high value of Z-score indicates high banking stability, which is inversely related to the probability of default (Li et al. 2017). As far as the Z-scores are positively skewed, the natural logarithm of the Z-scores is used, which approximates the values of the z-score to normal distribution (Laeven and Levine 2009).

(2) Independent Variables

Two groups of independent variables are examined in this paper. The first group is the country-specific indicators that include GDP growth, inflation, unemployment, and financial crisis. The second group is the bank-specific variables, efficiency, size, profitability, time effect, and country effect.

2.5.1. Country-Specific Variables

GDP growth: This variable is commonly examined in the literature as a proxy for systemic bank risks (Anjom and Karim 2016). This variable is also examined in the literature as a proxy for extended factors, such as aggregate economic activity and business cycles

(Al-Harbi 2017). Hamdi and Hakimi (2019); De-Ramon et al. (2020); and Pham et al. (2021) reported that GDP could have a positive effect on overall bank risks. However, other studies reported that GDP growth has negative impacts on overall bank risks (Imbierowicz and Rauch 2014; Ghenimi et al. 2017; Chen 2018; Ghassan and Guendouz 2019; Rahman et al. 2021). Accordingly, a hypothesis can be developed as follows:

Hypothesis H1. *GDP growth has a significant effect on overall bank risks.*

Inflation Rate: A number of related studies concluded that inflation has a negative effect on banks' Z-scores (Ghassan and Guendouz 2019; De-Ramon et al. 2020; Rahman et al. 2021). Nevertheless, other studies (Ghenimi et al. 2017; Abbas et al. 2021; Soebyakto et al. 2020; Pham et al. 2021) concluded that inflation and Z-score are positively associated.

Hypothesis H2. *Inflation has a significant effect on overall bank risks.*

Unemployment Rate: A number of related studies reported that unemployment has a significant negative influence on banks' Z-scores (Dawood et al. 2016; De-Ramon et al. 2020). It is measured by annual rate of unemployment.

Hypothesis H3. *Unemployment has a significant effect on overall bank risks.*

The Financial Crisis: Financial crisis results in loss of confidence in a country's currency or other financial assets causing international investors to withdraw their funds (Lee et al. 2013). According to many studies, financial crisis has a negative impact on the Z-score (Imbierowicz and Rauch 2014; Ghenimi et al. 2017; Chen 2018; Hamzani and Achmad 2018; Hamdi and Hakimi 2019). However, Beck et al. (2013) reported that financial crisis has a positive effect on the Z-score. Financial crisis is measured by a dummy variable (Ghenimi et al. 2017; Chen 2018; Hamdi and Hakimi 2019).

Hypothesis H4. *Financial crisis has a significant effect on overall bank risks.*

2.5.2. Bank-Specific Variables

Bank Operating Efficiency: Management efficiency is the quality of management in administrating costs that make the difference between unsound and sound banks. It is the cost of servicing and monitoring transactions. It can be noted that operating efficiency has a positive impact on the overall bank risks (Imbierowicz and Rauch 2014; Ghenimi et al. 2017; Chen 2018; Ghassan and Guendouz 2019; De-Ramon et al. 2020; Soebyakto et al. 2020; Rahman et al. 2021). According to different studies, the cost-income ratio measures efficiency (Ghosh 2017; Hamdi and Hakimi 2019; Rahman et al. 2021).

Hypothesis H5. *Operating Efficiency has a significant effect on overall bank risks.*

Bank Size: Size is the total asset that a bank owns (Lee et al. 2013). Size has a negative impact on the overall bank risks (Dawood et al. 2016; Ghenimi et al. 2017; Hamzani and Achmad 2018; Ghassan and Guendouz 2019). However, size and Z-score can be positively related (Imbierowicz and Rauch 2014; Pham et al. 2021; Nguyen 2020; Abbas et al. 2021). In numerous studies, the natural logarithm of total assets is used to proxy a bank's size (Ghassan and Guendouz 2019; Pham et al. 2021; De-Ramon et al. 2020; Abbas et al. 2021).

Hypothesis H6. *Size has a significant effect on overall bank risks.*

Bank Profitability: From one perspective, results show that profitability and overall bank risk are positively and significantly related (Ghenimi et al. 2017; Hamdi and Hakimi 2019; Abbas et al. 2021; Pham et al. 2021). Nevertheless, according to Jan and Marimuthu

(2015), profitability has a negative impact on Z-score. Return on equity (ROE) measures banks' profitability and indicates the rate of return on the shareholder's equity. This ratio is used in several studies (Pham et al. 2021; Nguyen 2020; Abbas et al. 2021).

Hypothesis H7. *Profitability has a significant effect on overall bank risks.*

Time effect (Duration): The authors offer a new variable to the related literature that reflects the time it takes for bank overall risks to increase or decrease over time. This variable is measured as a dummy variable that takes 1 in the case of an increase in the value of the Z score, and zero otherwise. The rationale of adding and examining this variable is derived from recent findings that the Z score can be extended as forward looking (Hafeez et al. 2022). Nevertheless, the question is how long it takes for the Z score to improve (that is, for bank risks to decrease).

Hypothesis H8. *Time effect has a significant effect on overall bank risks.*

Country effect: The country effect indicates that the bank overall risk may vary over time and across countries. This variable is measured as a dummy variable that equals 1 for a respective country and zero otherwise.

Hypothesis H9. *Country effect has a significant effect on overall bank risks.*

Table 1 summarizes the variables being examined in this paper.

Table 1. Variable Measurement.

Variable Type	Variable Name	Appreviation	Measurement
Dependent Variable	Bank Total Risks	Z-score	$Zscore_{it} = \frac{CAR_{it} + ROA_{it}}{\sigma_{ROA_{it}}}$ ROA = Net profit/Total assets CAR = Capital/Total Asset ratio. Capital includes equity plus reserves for loan loss, plus long-term debt σ_{ROA} = Volatility of Bank's ROA being measured by the standard deviation of ROA for the first two years rolling up to 20 years. The rolling basis ensures that time-varying volatility of ROA is accommodated.
Independent Variables	Growth Rate of Gross Domestic Product	GDP _{it}	Annual Growth rate
	Inflation	INF _{it}	Percentage change in Consumer Price Index
	Unemployment	UNM _{it}	Annual Rate of Unemployment
	Financial Crisis CRISIS _{it}	dummy variable	1 for the year 2008, and 0 otherwise
	Bank Efficiency EFF _{it}	Cost/Income ratio	Operating Costs/Operating Income
	Bank Size	SIZE _{it}	Natural Logarithm of Total Asset
	Profitability	ROE _{it}	Net Income after taxes/Total Equity
	Time Effect	Duration _{it}	Time effect using a dummy variable, when z score increases = 1, otherwise = 0
	Country Effect	Countryeffect _{it}	Country effect using a dummy variable = 1 for a respective country, 0 otherwise

3. Results and Discussion

3.1. Descriptive Statistics

Descriptive statistics provide a summary of the variables examined in this paper. Table 2 shows the mean, median, minimum, maximum, and standard deviation values for all variables examined in this paper.

Table 2. Descriptive Statistics.

	Mean	Median	Minimum	Maximum	Std. Deviation
GDP annual growth rate	0.0338	0.0300	−0.0808	0.1923	0.0452
Inflation Annual Rate	0.0626	0.0371	−0.0486	0.2951	0.0611
Unemployment Annual Rate	0.0708	0.0820	0.0011	0.1358	0.0409
Financial Crisis (Dummy variable)	0.3911	0.0000	0.0000	1.0000	0.4883
Cost/income ratio	0.3830	0.3678	0.0000	0.8344	0.1158
Bank Size (natural log of Total Assets)	6.6439	4.3635	0.0000	19.2761	3.7143
Return on Equity	2.5017	0.1543	−3.0436	55.7300	8.8210
Time effect (Duration of an increase in Z score)	6.9926	7.0000	0.0000	14.0000	3.8234
KSA (Dummy Variable)	0.2121	0.1801	0.0000	1.0000	0.4091
Kuwait (Dummy Variable)	0.1515	0.0000	0.0000	1.0000	0.3588
Qatar (Dummy Variable)	0.1515	0.0000	0.0000	1.0000	0.3588
UAE (Dummy Variable)	0.1818	0.0000	0.0000	1.0000	0.3860
Egypt (Dummy Variable)	0.1818	0.0000	0.0000	1.0000	0.3860
Morocco (Dummy Variable)	0.1212	0.0000	0.0000	1.0000	0.3266
Bank Total Risk (Z-score)	3.4960	3.0138	−2.5608	65.2293	4.4888

3.2. The Significance of Country-Specific and Bank-Specific on Overall Bank Risks

The results in Table 3 show that the insignificant estimate of GDP indicated that banks' total risks were managed apart from the changes in GDP growth. That is, bank's activities were not that supportive to economic growth in the respective countries. However, this finding was in contrast with the majority of studies that have stated a significant relationship between GDP and Z-score (Imbierowicz and Rauch 2014; Ghenimi et al. 2017; Chen 2018; Ghassan and Guendouz 2019; Hamdi and Hakimi 2019; De-Ramon et al. 2020; Pham et al. 2021; Rahman et al. 2021).

The results also showed inflation having a positive impact on banks' Z-score. This result could be interpreted a a higher inflation level reduced the value of loans over the years, which strengthened the borrower's repayment capacity, thus increasing the stability of banks, which drove the Z-score up and the overall risk fell. The findings of many related studies reinforce this result (Ghenimi et al. 2017; Abbas et al. 2021; Soebyakto et al. 2020; Pham et al. 2021). However, it contradicts the results of other studies that state inflation and Z-score are negatively related (Ghassan and Guendouz 2019; De-Ramon et al. 2020; Rahman et al. 2021).

The negative effect of unemployment rate on banks' Z-score could be interpreted as a higher level of unemployment rate reduced the national income and thereby weakened the borrowers' repayment capacities. As a result, credit risk increased, which affected bank stability and the overall risk negatively. The same result has been reached and reported by Dawood et al. (2016) and De-Ramon et al. (2020).

The positive effect of financial crisis could be attributed to the fact that some MENA countries were affected by the financial crisis since their financial systems were integrated with the global financial system. This was also supported by the fact that there was a significant presence of state-owned banks in the MENA region which justified the positive

impact of the financial crisis on the Z-score (Beck et al. 2013). However, according to most studies, the financial crisis had a negative impact on the Z-score (Imbierowicz and Rauch 2014; Ghenimi et al. 2017; Chen 2018; Hamzani and Achmad 2018; Hamdi and Hakimi 2019).

Table 3. The Effect of Country-Specific Variables on Banks' Z-score. The dependent variable was Z-score, being a proxy for the overall bank risks. The independent variables were classified into two groups: country-specific and bank-specific variables. The multicollinearity was examined using the VIF test. All variables were associated with VIF < 10 (Gujarati 2003). The results are reported in Table A1. The presence of heteroscedasticity was examined in the regression model by conducting the Breusch-Pagan test. The results in Table A4 show that the error variance was constant and had no heteroscedasticity problem. The presence of autocorrelation was examined as well using the Durbin-Watson test. Therefore, the first difference transformation was applied to sort out the autocorrelation problem.

Variable	Coefficient	
	Country-Specific	Bank-Specific
Constant	2.846728 (7.11) ***	7.422686 (8.981031) ***
GDP growth	3.783090 (0.95)	
Inflation Rate	5.631 (1.97) **	
Unemployment Rate	−12.589 (−2.78) ***	
Financial Crisis	2.709 (7.85) ***	
Cost/Income ratio		−5.464 (−3.15) ***
Bank Size		−0.090 (−1.53)
Return on Equity		−0.043 (−2.074) **
Time effect (Duration)		−0.1392 (−3.171) ***
Country effect (UAE)		0.1729 (0.354)
Country effect (Egypt)		−0.516 (−0.938)
Country effect (Morocco)		−0.721 (−1.080)
Country effect (Kuwait)		Omitted
Country effect (Qatar)		Omitted
N	660	660
Adjusted R-squared	0.1056	0.0331
F-statistic	21.433 ***	4.392 ***
D-W	2.851	2.331

** Significant at 5%, *** Significant 1%.

In the case of bank-specific factors, the negative effect of Cost/Income on the Z-score indicated that a higher level of operating efficiency (lower ratio of Cost/Income) implied that banks in the MENA region had sound management in administrating internal costs.

In this regard, improvements in the operating efficiency strengthen banks' performance and survival. The significance of operating efficiency has been reported in several related studies, such as those by [Imbierowicz and Rauch \(2014\)](#); [Ghenimi et al. \(2017\)](#); [Chen \(2018\)](#); [Ghassan and Guendouz \(2019\)](#); [De-Ramon et al. \(2020\)](#); [Soebyakto et al. \(2020\)](#) and [Rahman et al. \(2021\)](#).

It is worth mentioning that the insignificant estimates of size of the bank imply that banks in the MENA region depended heavily on the quality of the investments, apart from the size of the assets relative to its capital, thus the Z-score was unaffected. Nevertheless, this result contradicts most of the studies that argue bank size has a significant impact on the Z-score ([Imbierowicz and Rauch 2014](#); [Dawood et al. 2016](#); [Ghenimi et al. 2017](#); [Hamzani and Achmad 2018](#); [Chen 2018](#); [Ghassan and Guendouz 2019](#); [Pham et al. 2021](#); [Nguyen 2020](#); [Abbas et al. 2021](#)).

The negative effect of profitability on banks' overall risks could be attributed to the fact that a higher profit margin encouraged banks in the MENA region to invest in risky investments that increased the overall risk ([Jan and Marimuthu 2015](#)). Nevertheless, opposite results are reported by other studies, such as [Ghenimi et al. \(2017\)](#); [Hamdi and Hakimi \(2019\)](#); [Abbas et al. \(2021\)](#) and [Pham et al. \(2021\)](#).

The negative effect of duration (the time it took for the Z score to improve) showed that the Z-score decreased over the years. That is, the overall risk increased over time.

In terms of country effects, the results showed that differences between and among the countries considered in this paper were insignificant. This could very much be attributed to the shared and common banking practices in the region.

It is worth noting that the explanatory powers of the two models are quite indicative. That is, the explanatory power of the country-specific variables (0.1056) was three folds that of the explanatory power of bank-specific variables. This result reflected the intrinsic nature of the banking business that is quite affected by macroeconomic conditions, which has been examined extensively in terms of determinants of bank systemic risks ([Mainik and Schaanning 2014](#); [López-Espinosa et al. 2015](#); [Teply and Kvapilikova 2017](#); [Varotto and Zhao 2018](#); [Weiß et al. 2014](#)).

4. Testing for Robustness

The robustness of the results was examined in two approaches. The first approach examined the robustness in terms of the stability of the estimated coefficients in two periods. The first period was 2000–2010. The second period was 2011–2020. The second approach examined the robustness of the results in terms of the scale of banks' Z-scores. The latter was arranged in an ascending order. The stability of the coefficient was examined in the 1st quartile and the 4th quartile. The results of the robustness tests are reported in Tables 4 and 5.

The results in Table 4 show that the estimate for the inflation rate was still positive and significant, but only in the period 2011–2020. The estimate for the financial crisis was robust as well but in the period 2000–2010 as it carried the same positive trend and significance as reported in Table 3.

The same argument applies to the estimate of unemployment rate which was negative and significant in the period 2000–2010.

The estimates for cost/income ratio and ROE carried negative and significant associations as reported in Table 3, but only in the period 2010–2020.

The results in Table 4 also show that the estimate of the time effect (duration) was not robust as it changed the trend. The same was true for the estimates of the country effects, in that they were not robust as they changed the significance.

It is worth noting that the explanatory power of the estimates in the period 2011–2020 was the highest. This result indicated that this period was quite indicative in terms of bank-specific variables.

Table 4. The Robustness of the Stability of the Estimated Coefficients over Time.

Variable	Country-Specific Estimates		Bank-Specific Estimates	
	2000–2010	2011–2020	2000–2010	2011–2020
Constant	11.102 (1.233176)			
GDP growth	−70.49 (−1.225)	10.092 (4.718) ***		
Inflation Rate	53.416 (1.021)	2.904 (2.244) **		
Unemployment Rate	−161.55 (−1.886) *	4.968 (0.0187) **		
Financial Crisis	17.382 (2.610) ***	Omitted		
Cost/Income ratio			−7.542 (−0.499)	−3.815 (−5.502) ***
Bank Size			4.873956 (1.294)	−0.0065 (−0.082)
ROE			0.0133 (0.076)	−0.004 (−2.164) **
Time effect (Duration)			21.7406 (2.620) ***	−0.208702 (−0.960)
Country effect (UAE)			2.414866 (0.115202)	0.9377 (1.884) *
Country effect (Egypt)			Omitted	0.654020 (2.877) ***
Country effect (Morocco)			Omitted	Omitted
Country effect (Kuwait)			35.867149 (1.205488)	Omitted
Country effect (Qatar)			45.787833 (1.575197)	Omitted
N	355	330	341	320
Adjusted R-squared	0.0141	0.1155	0.0257	0.14575
F-statistic	2.268 *	15.289 ***	2.281 **	10.070 ***
D-W	0.9863	0.4896	1.0463	0.6636

* Significant at 10%, ** Significant at 5%, *** Significant 1%.

The results in Table 5 show that the estimate of inflation rate was not robust as it reversed the sign in the case of high total risk (4th Quartile). The negative effect of unemployment rate was robust for high total bank risks, especially in the period 2000–2010. Nevertheless, this effect was positive for low total risk banks, especially in the period 2011–2020.

The positive effect of financial crisis was still robust for the period 2000–2010, but only for low total banks risks.

The negative effect of cost/income ratio was still robust in the period 2010–2020, but only for high total bank risk. In terms of bank asset and liability management, this result calls for the adoption of cost reduction strategies in order to reduce overall bank risks.

The results in Table 5 show that the robustness of the ROE disappeared as the estimates for the low and high overall bank risks were insignificant.

The negative effect of duration was robust for low overall bank risks. This result is conceivable as low-risk banks are able to manage overall bank risk in a shorter time than high overall bank risks, where the effect of duration is positive.

In terms of the country effect, the results in Table 5 show that the overall bank risks had positive effects in Egypt only during the period 2000–2010, but negative and significant effect in the period 2011–2020. where overall bank risks reduced.

As far as the explanatory power is considered, the results in Table 5 show that the 4th quartile of banks' Z score (low risk) was quite indicative.

Table 5. The Robustness of the Scale of Total Bank Risks.

Variables	1st Quartile (High Overall Risk)	4th Quartile (Low Overall Risk)
Constant	1.0019 (3.315) ***	35.831 (1.270)
GDP growth	1.251 (0.881)	−35.131 (−0.594)
Inflation Rate	0.7299 (0.484)	−98.380 (−1.698) *
Unemployment Rate	−5.669 (−2.836) ***	482.862 (2.893) ***
Financial Crisis	−0.208 (−1.364)	28.879 (4.277) ***
Cost/Income ratio	−0.838 (−1.911) *	−26.925 (−1.381)
Bank Size	0.021 (0.464)	−4.474 (−1.179)
ROE	0.003 (1.379)	−0.1311 (−0.623)
Time effect (Duration)	0.353 (1.970) **	−13.048 (−2.244) **
Country effect (UAE)	0.160 (0.548)	−0.176 (−0.006)
Country effect (Egypt)	0.548 (2.301) **	−53.278 (−4.614) ***
Country effect (Morocco)	Omitted	Omitted
Country effect (Kuwait)	Omitted	Omitted
Country effect (Qatar)	Omitted	Omitted
N	171	169
Adjusted R-squared	0.1202	0.2264
F-statistic	3.323 ***	4.783 ***
Std. Error of the Estimate	0.722	0.26605
D-W	1.687	0.916

* Significant at 10%, ** Significant at 5%, *** Significant 1%.

5. Conclusions

Many studies in the literature have examined the determinants of overall bank risks, with inconsistent results between countries. This motivated the present examination of the robustness of the determinants of overall bank risk in the MENA region where systemic risks were observed.

The paper reached the conclusions that follow:

- (a) The unemployment rate had a negative effect on high overall bank risks in the period 2000–2010. This result reflects a reality about the job market in the MENA region at large and its effects on overall bank risk. It is conceivable that unemployment hinders

banks from lending, and, to a large extent, loans are subject to high probability of default due to the inability to pay them off. According to the estimates of the [World Economic Outlook \(2021\)](#), the average unemployment rate in the MENA was estimated to be 13.2%. It was the highest average rate in comparison to the world average (6.3%), the average in East Asia (3.8%), and the average in South Asia (4.7%). Nevertheless, this effect became positive for low overall risk banks, especially in the period 2011–2020. In terms of robustness, the effect of unemployment in Egypt was quite robust. During the period of the study, the average unemployment growth rate reached 10.71% ([World Economic Outlook 2021](#)), which was the highest average in the world regions.

- (b) The financial crisis had a positive effect on the MENA overall bank risks in the period 2000–2010, but only for the low overall bank risks.
- (c) Bank operating efficiency played a significant role in improving overall bank risks. A robust and negative effect of cost/income ratio was observed in the period 2010–2020, but only for high overall bank risk. In terms of bank asset and liability management, this result calls for the adoption of cost reduction strategies to reduce the overall bank risks.
- (d) An extended contribution of this paper was that it examined the time effect, referred to in this paper as “duration” effect. The results showed that low overall-risk banks were able to manage overall risks in a shorter time than high overall bank risks, where the effect of duration was positive.
- (e) In terms of the country effect, the results for Egypt only showed that the overall bank risk had positive effects in the period 2000–2010, but negative and significant effects in the period 2011–2020, where overall bank risks reduced.

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Appendix A

Table A1. Test of Multicollinearity.

Research Variables	VIF
GDP	1.507
Inflation	1.530
Unemployment	4.455
Financial Crisis	1.104
Cost/income	1.449
Bank Size	4.530
ROE	1.238
Time effect	1.044
Country effect (UAE)	1.431
Country effect (Egypt)	4.275
Country effect (Morocco)	3.320

Table A2. The results of the Hausman Test for Country-specific Variables. The Hausman Specification test was carried out. The null and alternative hypotheses were as follows. Ho: Random-effects model is appropriate; H1: Fixed-effects model is appropriate.

Variables	Fixed Effect		Random Effect		Hausman Test
	Coefficient	Prob.	Coefficient	Prob.	
C	0.174881	0.0000	0.181683	0.0000	0.0007
GDP	0.015534	0.6606	0.003385	0.9225	
Inflation	−0.021893	0.4165	−0.004926	0.8501	
Unemployment	−0.006877	0.9369	−0.109801	0.0884	
Financial Crisis	0.003154	0.2730	0.002724	0.3374	

The results in Table A2 show that the fixed effect fit the underlying data.

Table A3. The results of the Hausman Test for Bank-specific Variables. The Hausman Specification test was carried out. The null and alternative hypotheses were as follows. Ho: Random-effects model is appropriate; H1: Fixed-effects model is appropriate.

Variables	Fixed Effect		Random Effect		Hausman Test
	Coefficient	Prob.	Coefficient	Prob.	
C	0.178618	0.0000	0.182214	0.0000	0.2274
Cost/Income	0.038562	0.0142	0.033665	0.0271	
Bank Size	−0.002939	0.0143	−0.001950	0.0195	
ROE	−0.000349	0.0714	−0.000352	0.0574	
Time effect	0.000257	0.4471	0.000250	0.4590	
Country effect (UAE)	NA	NA	0.014863	0.1023	
Country effect (Egypt)	NA	NA	−0.017603	0.0623	
Country effect (Morocco)	NA	NA	−0.063841	0.0000	

The results in Table A3 show that the random effect fit the underlying data.

Table A4. The results for Heteroskedasticity using the Breusch-Pagan/Cook-Weisberg test (Greene 2003; Gujarati 2003). H_0 : the variance of error terms is constant (homogenous). H_1 : the variance of error terms is not constant (Heterogenous).

Chi Square Statistics	
GDP growth	$\chi^2 (1) = 566.23$ (Prob > $\chi^2 = 0.0721$)
Inflation Rate	$\chi^2 (1) = 825.11$ (Prob > $\chi^2 = 0.3401$)
Unemployment Rate	$\chi^2 (1) = 658.69$ (Prob > $\chi^2 = 0.2917$)
Financial Crisis	$\chi^2 (1) = 813.83$ (Prob > $\chi^2 = 0.0918$)
Cost/Income ratio	$\chi^2 (1) = 639.46$ (Prob > $\chi^2 = 0.3521$)
Bank Size	$\chi^2 (1) = 558.82$ (Prob > $\chi^2 = 0.7421$)
Return on Equity	$\chi^2 (1) = 459.83$ (Prob > $\chi^2 = 0.7421$)

Table A5. List of the banks examined in this paper.

Country	Bank
KSA	National Commercial Bank (NCB)
KSA	Saudi Hollandi Bank (Alawwal)
KSA	Riyad bank (RIBL)
KSA	Saudi British Bank (SAAB)
KSA	Samba Financial Group
KSA	Arab National Bank (ANB)
KSA	Banque Saudi Fransi JSC
Kuwait	National Bank of Kuwait
Kuwait	Gulf Bank
Kuwait	Commercial Bank of Kuwait (CBK)
Kuwait	Burgan Bank (BURG)
Kuwait	Al Ahli Bank of Kuwait (ABK)
Qatar	Qatar National Bank
Qatar	Commercial Bank of Qatar (COMB)
Qatar	Doha Bank
Qatar	Ahli Bank (AABQ)
Qatar	Al Khalij Commercial Bank (KCB)
UAE	Abu Dhabi Commercial Bank (ADCB)
UAE	National Bank of Fujairah PJSC
UAE	The National Bank of Ras al-khaimah (RAK)
UAE	Commercial Bank International (CBI)
UAE	National Bank of Umm Al-Qaiwain (NBQ)
UAE	Mashreqbank
Egypt	The National Bank of Kuwait—Egy
Egypt	Société Arabe Internationale de Banque (SAIB)
Egypt	Suez Canal Bank
Egypt	Credit Agricole Egypt (CIEB)
Egypt	Commercial International Bank (CIB)
Egypt	Egyptian Gulf Bank (EGB)
Morocco	aAttijariwafa bank
Morocco	Banque Centrale Populaire (BCP)
Morocco	Bank of Africa Banque Marocaine du Commerce Extérieur (BCME)
Morocco	Crédit Agricole du Maroc (CDM)

References

- Abbas, Faisal, Omar Masood, and Shoaib Ali. 2021. Financial development and bank risk-taking: Empirical evidence from the USA. *Intellectual Economics* 15: 64–87.
- Abdelaziz, Hakimi, Boussaada Rim, and Hamdi Helmi. 2022. The interactional relationships between credit risk, liquidity risk and bank profitability in MENA region. *Global Business Review* 23: 561–83. [\[CrossRef\]](#)
- Abuzarqa, Rawan. 2019. Banking risk management according to the requirements of the Basel Agreements. *Practical Application of Science* 7: 29–38.
- Al-Harbi, Ahmad. 2017. Determinants of banks liquidity: Evidence from OIC countries. *Journal of Economic and Administrative Sciences* 33: 164–77.
- Anjom, Washeka, and Asif Mahbub Karim. 2016. Relationship between non-performing loans and macroeconomic factors with bank-specific factors: A case study on loan portfolios—SAARC countries perspective. *ELK Asia Pacific Journal of Finance and Risk Management* 7: 1–29.
- Beck, Thorsten, Asli Demirgüç-Kunt, and Ouarda Merrouche. 2013. Islamic vs. conventional banking: Business model, efficiency and stability. *Journal of Banking and Finance* 37: 433–47. [\[CrossRef\]](#)
- Bouvatier, Vincent, Laetitia Lepetit, Pierre-Nicholas Rehault, and Frank Strobel. 2018. Bank Insolvency Risk and Z-Score Measures: Caveats and Best Practice. Working Paper. Available online: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2892672 (accessed on 12 May 2022).
- Boyd, John H., and Stanley L. Graham. 1986. *Risk, Regulation, and Bank Holding Company Expansion into Nonbanking*. Quarterly Review. Minneapolis: Federal Reserve Bank of Minneapolis, vol. 10, pp. 2–17. [\[CrossRef\]](#)
- Boyd, John H., Stanley L. Graham, and R. Shawn Hewitt. 1993. Bank holding company mergers with nonbank financial firms: Effects on the risk of the failure. *Journal of Banking and Finance* 17: 43–63. [\[CrossRef\]](#)
- Chen, Zhizhen. 2018. Loan Securitization, Bank Risk, and Efficiency. Ph.D. thesis, University of Glasgow, Glasgow, UK.

- Dawood, Ashraf, Muhammad Suhail Rizwan, and Barbara L'Huillier. 2016. A net stable funding ratio for Islamic banks and its impact on financial stability: An international investigation. *Journal of Financial Stability* 25: 47–57.
- De-Ramon, Sebastian J. A., William B. Francis, and Michael Straughan. 2020. *The Link between Bank Competition and Risk in the United Kingdom: Two Views for Policymaking*. Bank of England Working Paper No. 885. London: Bank of England.
- Ghassan, Hassan Belkacem, and Abdelkrim Ahmed Guendouz. 2019. Panel modeling of z-score: Evidence from Islamic and conventional Saudi banks. *International Journal of Islamic and Middle Eastern Finance and Management* 12: 448–68. [CrossRef]
- Ghenimi, Ameni, Hasna Chaibi, and Mohamed Ali BrahimOmri. 2017. The effects of liquidity risk and credit risk on bank stability: Evidence from the MENA region. *Borsa Istanbul Review* 17: 238–48. [CrossRef]
- Ghosh, Saibal. 2017. Corporate governance reforms and bank performance: Evidence from the Middle East and North Africa. *Corporate Governance: The International Journal of Business in Society* 17: 822–44. [CrossRef]
- Greene, William. H. 2003. *Econometric Analysis*, 5th ed. Englewood Cliffs: Prentice Hall.
- Gujarati, Damodar N. 2003. *Basic Econometrics*, 4th ed. New York: McGraw-Hill.
- Hafeez, Bilal, Xiping Li, M. Humayun, and David Tripe. 2022. Measuring bank risk: Forward-looking z-score. *International Review of Financial Analysis* 80: 1–14. [CrossRef]
- Hamdi, Helmi, and Abdelaziz Hakimi. 2019. Does liquidity matter on bank profitability? Evidence from a nonlinear framework for a large sample. *Business and Economics Research Journal* 10: 13–26. [CrossRef]
- Hamzani, Umiaty, and Dinarjad Achmad. 2018. Bankruptcy prediction: SMEs case study in Pontianak, Indonesia. *Accounting and Finance Review* 3: 9–15.
- Hannan, Timothy, and Gerald G. A. Hanweck. 1988. Bank insolvency risk and the market for large certificates of deposit. *Journal of Money, Credit and Banking* 20: 203–11. [CrossRef]
- Hausman, Jerry A. 1978. Specification tests in econometrics. *Econometrica: Journal of the Econometric Society* 46: 251–1271. [CrossRef]
- Hausman, Jerry A., and William E. Taylor. 1981. Panel data and unobservable individual effects. *Econometrica: Journal of the Econometric Society* 49: 1377–98. [CrossRef]
- Hossain, Mohammad Kamal. 2020. Relationship between Internal Corporate Governance Mechanisms and Shareholder Value in the Banking Sector in Bangladesh: The Mediating Effect of Non-Equity Stakeholders. Ph.D. thesis, Cardiff Metropolitan University, Cardiff, UK.
- Imbierowicz, Bjorn, and Christian Rauch. 2014. The relationship between liquidity risk and credit risk in banks. *Journal of Banking and Finance* 40: 242–56. [CrossRef]
- Jan, Amin, and Maran Marimuthu. 2015. Bankruptcy and Sustainability: A Conceptual Review on Islamic Banking Industry. *Global Business and Management Research: An International Journal* 7: 109–38.
- Köhler, Matthias. 2012. Which Banks Are More Risky? The Impact of Loan Growth and Business Model on Bank Risk-taking. Bundesbank Discussion Paper No. 33/2012. Available online: <https://ssrn.com/abstract=2796886> (accessed on 18 May 2022).
- Laeven, Luc, and Ross Levine. 2009. Bank governance, regulation and risk taking. *Journal of Financial Economics* 93: 259–75. [CrossRef]
- Lee, Kar Choon, Lim L. Y. Hooi, Thatshana Murthi Lingesh, Soon Yi Tan, and Yee Shven Teoh. 2013. The Determinants Influencing Liquidity of Malaysia Commercial Banks, and Its Implication for Relevant Bodies: Evidence from 15 Malaysia Commercial Banks. Master's thesis, Tunku Abdul Rahman University, Kuala Lumpur, Malaysia.
- Lepetit, Laetitia, and Frank Strobel. 2015. Bank Insolvency Risk and Z-Score Measures: A Refinement. *Finance Research Letters* 13: 214–24. [CrossRef]
- Li, Xi-ping, David Tripe, and Christopher B. Malone. 2017. Measuring bank risk: An exploration of Z- score. *Social Science Research Network (SSRN)*, 1–38. [CrossRef]
- López-Espinosa, Germán, Antonio Moreno, Antonio Rubia, and Laura Valderrama. 2015. Systemic risk and asymmetric responses in the financial industry. *Journal of Banking and Finance* 58: 471–85. [CrossRef]
- Mainik, Georg, and Eric Schaanning. 2014. On dependence consistency of CoVaR and some other systemic risk measures. *Statistics and Risk Modeling* 31: 49–77. [CrossRef]
- Nguyen, Van Chien. 2020. Human capital, capital structure choice and firm profitability in developing countries: An empirical study in Vietnam. *Accounting* 6: 127–36. [CrossRef]
- Pham, Thuy Tu, Le Kieu Oanh Dao, and Van Chien Nguyen. 2021. The determinants of bank's stability: A system GMM panel analysis. *Cogent Business and Management* 8: 1963390. [CrossRef]
- Rahman, Syed Md, Mohammad Ashraful Ferdous Chowdhury, and Tasmina Chowdhury Tania. 2021. Nexus among Bank Competition, Efficiency and Financial Stability: A Comprehensive Study in Bangladesh. *The Journal of Asian Finance, Economics, and Business* 8: 317–28.
- Roy, Andrew Donald. 1952. Safety first and the holding of assets. *Econometrica* 20: 431–49. [CrossRef]
- Soebyakto, Bambang Bemby, Fida Muthia, and Muizzuddin Mohamad Adam. 2020. May. Joint Effect of Banking Competition and Risk-Taking on Profitability: Evidence from ASEAN's countries. Paper presented at the 5th Sriwijaya Economics, Accounting, and Business Conference (SEABC 2019), Palembang, Indonesia, November 6–7; Paris: Atlantis Press, pp. 436–440.
- Teply, Petr, and Ivana Kvapilíková. 2017. Measuring systemic risk of the US banking sector in time-frequency domain. *North American Journal of Economics and Finance* 42: 461–72. [CrossRef]
- Varotto, Simone, and Lei Zhao. 2018. Systemic risk and bank size. *Journal of International Money and Finance* 82: 45–70. [CrossRef]

- Weiß, Gregor N. F., Deneba Bostandzic, and Sascha Neumann. 2014. What factors drive systemic risk during international financial crises? *Journal of Banking and Finance* 41: 78–96. [CrossRef]
- World Economic Outlook. 2021. Available online: <https://www.imf.org/en/Publications/WEO/Issues/2021/01/26/2021-world-economic-outlook-update> (accessed on 4 April 2022).
- Yitayaw, Mekonnen Kumlachew. 2021. Firm-specific and macroeconomic determinants of commercial banks liquidity in Ethiopia: Panel data approach. *Cogent Business and Management* 8: 1–18. [CrossRef]