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Systemic Risk's Effect on the Stability of the Banking Sector: Evidence from Saudi Arabia

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Abstract: The banking sectors are exposed to a lot of pressure due to the events taking place in the region, the most important of which is the decline in global oil prices and geopolitical events that led to political instability in the Middle East. This paper aims to study the macroeconomic variables that could be potential sources of systemic risks and to test their impact on the stability of the banking sector in the Kingdom of Saudi Arabia (1984-2020), using the ARDL approach of Co- integration and stability testing. In light of the economic theory and literature, systemic risks were identified by fluctuations in oil prices, interest rates, inflation and political instability as independent variables. The results showed a significant positive effect of oil prices and inflation on the banking sector's total assets and total deposits. In addition, the interest rate has a negative effect on total assets while positively affecting total deposits. Furthermore, political instability significantly affects the total assets of the banking sector during the Yemeni war, while there is insufficient evidence about its impact on total deposits.

Keywords: Systemic Risks, Interest rate, Inflation, Political instability, ARDL.

1. Introduction

In light of the events that the world is witnessing today and the Middle East in particular, the conflicts between the major powers have led to the reshaping of the regional geopolitical space by building new alliances in search of a more influential role in the region. These events forced these countries to rearrange their economic priorities in line with the current situation. Saudi Arabia is one of the countries that have adopted a package of economic and financial reforms, identified by Vision (2030) and the National Transformation Program (2020), both of which aimed to mitigate the negative effects of the global contraction in oil prices and the decline in oil export revenues as a main source of income in Saudi Arabia. The banking sector is considered one of the most important sectors that contribute to the financial reform processes and move the wheel of growth by mobilizing national savings and re-injecting them into various economic sectors in the form of loans, as the banking sector contributes 10.3% of the Saudi GDP (SAMA, 2019). Currently, the banking sectors around the world are under great the increase in the systemic risks that are exposed, therefore the existence of a state of banking instability that may cause a new financial crisis (Bougheas & Kirman, 2018; Liu et al., 2022; Foglia & Angelini, 2021; Rizwan et al., 2020). According to Acharya et al. (2010) and Hochrainer-Stigler et al. (2020), Systemic risk is measured as the amount by which a bank's capital is reduced due to a structured event in which the financial system is completely deficient in capital and is known as regular expected deficit, this concept implies the amount of the market value of shares (Cao, 2021). In which the bank falls below its target value. This idea is attractive because it uses industry data that can be easily accessed by regulators and market participants, as academics have developed various concepts and suggestions for measuring systemic risk, classifying systemically significant financial institutions, and tracking determinants of systemic risk (Choi et al., 2020; Schweizer, 2021; Steffen, 2012). Many banks suffer from the negative effects of the global financial crisis of 2008, which forced these banks to carry out large write-offs and increase the capital requirements imposed by the competent authorities in accordance to Basel 3 Agreement (Hoque & Liu, 2021). The resilience of the banking system must be strengthened in the face of potential negative shocks, which have become a feature of the era (Beltrame et al., 2018). Accurate and timely identification of the systemic risks banks face is important for potential reactions. As the structure of the banking system is linked to exposure to these risks at the macroeconomic level, and therefore it is required to improve the control and management of these risks, especially with regard to market risk (MR) and interest rate risk (IRR) (von la Hausse et al., 2016).

This paper seeks to analyze and discuss the nature of systemic risks and how they affect the stability of the Saudi banking sector. Systemic risks in Saudi Arabia arise from many variables, the most important of which is the volatility and decline in oil prices, which affects various sectors, including the banking sector which is affected indirectly through macroeconomic variables according to the hypothesis of indirect effect (Hesse & Poghosyan, 2009). The war in Yemen also caused a state of political instability in the region, especially in Saudi Arabia, as the leader of the coalition forces to support the legitimate authority in Yemen. As Saudi Arabia realized the geopolitical and economic geography of Yemen, which made it in constant conflict with Iran, which supports the Houthi group, in order to protect the oil paths in the Red Sea and control the strategic strait that threatens the interests of the Gulf States and supervises the course of international trade (Abdullah, 2020). Kazem and Hashem (2016) confirm that the events of the Arab Spring that began in 2010 led to a change in Saudi behavior in redrawing its geopolitical map by building new alliances that enabled it to play a more influential role in the political events in the Arab region. Thus, the emergence of Saudi Arabia as a parallel power to Iran, whose influence increased in the region. Numerous studies confirm that political instability affects the economic growth of the country as a whole, as higher level of political instability led to a decline in the economic growth of the country (Saif-alyousfi, 2020). Argues

Ghosh, (2016) that the political instability resulting from the Arab Spring has negatively affected the performance of the banking sector in Arab countries. Also, the risks of inflation and interest rate fluctuations in the market are a major concern of fluctuations in income and the value of assets in the banking sector according to the classification of banking risks. These risks arise as a result of banks' acceptance of financial instruments subject to fluctuations in market prices provided as gurrantees for loans granted by banks (Mudanya, 2018).

Our study contributes to the literature in many ways. First, it explores the impact of systemic risks on the banking system's stability, especially the commercial banks in Saudi Arabia. Unlike many studies that focused on internal factors only, including bank size, liquidity risk, credit risk, operational risk and leverage ratios (e.g., Djebali & Zaghdoudi, 2020; Shaik & Sharma, 2021; Hacini et al., 2021; Ghenimi et al., 2017; Ghassan & Fachin, 2016; Ghazi & Tayachi, 2021), this study focused on external factors like oil prices, inflation, political instability, and interest rate. Second, this study uses the ARDL approach of Co- integration and stability testing. To the best of our knowledge, this approach has not been used to measure the impact of systemic risk on the bank's stability in Saudi Arabia. Finally, Since the Saudi economy is largely based on oil revenues, and thus the sensitivity of economic sectors, including the banking sector, to changes in oil prices, this prompted researchers to explore the impact of oil prices on the stability of banks in Saudi Arabia.

2. Literature review

There are many studies conducted in Saudi Arabia that examined the relationship between internal factors, including (capital risk, liquidity risk, credit risk, and operational risk and leverage ratios) and the stability of the banking sector. Djebali & Zaghdoudi (2020) aimed to examine the impact of liquidity risk and credit risk on the stability of commercial banks in 11 countries of the MENA region, including Saudi Arabia. By Using Panel Smooth Threshold Regression (PSTR), the study concluded that both liquidity risks and credit risks had a negative effect on the stability of commercial banks. Ghenimi et al. (2017) studied the relationship between liquidity risk and credit risk and its impact on the stability of commercial banks in the MENA region, including Saudi Arabia. The results of the study indicated that there is no economically meaningful relationship between liquidity risk and credit risk. However, both risks separately affect negatively the stability of commercial banks. Shaik & Sharma (2021) discussed the effect of capital and leverage ratios on the profitability of commercial banks in Saudi Arabia. The study found a positive relationship between the debt-to-equity ratio and the profitability of commercial banks. The study also indicated that the Tier 1 capital ratio positively affected the return on equity and the return on assets, while it negatively and insignificantly affected the earnings per share of commercial banks in Saudi Arabia.

Regarding systemic risk, several studies that examined the relationship between systemic market risks and the performance of the banking sector have been done which varied according to time and place. Shah et al. (2020) shows that asset quality, liquidity, company size, and profit efficiency are major determinants of the systemic risk of Pakistani banks. Using the data of 21 banks in Nigeria during (2005-2014), Ezekiel et al. (2016) concluded that there is a positive correlation between prudential market risk management practices and the financial performance of banks, as banks must follow prudential policies and regulatory principles to reduce market risks. Brătianu et al. (2016) suggest a practical method for estimating market risk by calculating the value at risk index (VaR), which depends on the availability of daily data on asset prices in the portfolio by providing a practical example for managing an investment portfolio (n). Using data from seven banks at the Tehran Stock Exchange, Gerami and Sajjadi (2017) presented a model for assessing market risk and calculating the value at risk index using of the fuzzy data envelopment analysis (DEA) models. Risk factors in bank operation were determined according to inefficiency in loan collection as inputs to the model. Saif-alyousfi (2020) concluded that the political instability in the GCC countries resulting from the war in Yemen had a negative impact on the deposits and loans of Gulf banks, according to direct impact hypothesis as participation in the Yemen war. The study of Hesse and Poghosyan (2009) examined the direct and indirect effects of oil price shocks in the Middle East and North Africa region (MENA) on the profitability of banks. The paper concluded that there was an indirect effect on the profitability of banks through macroeconomic variables, while the direct impact was weak. Saif-alyousfi et al. (2018) discussed the development of the banking sector in the GCC countries and the impact of oil prices during (2000-2014) and concluded that there was a sharp growth in credit parallel to the increase in oil prices, which negatively affected the liquidity position in banks. Mudanya (2018) study showed that there is a strong negative relationship between market risks and bank profitability, stressing the need to hedge against market risks, which include the risks of stock prices, interest rates and exchange rates. Butzbach (2016) indicated that banks must face systemic risks by strengthening diversification policies, ensuring the availability of partial and macro-prudential policy tools, and knowing the links between systemic risks and banking diversification. Lin et al. (2018) discussed how financial institutions are exposed to systemic risk using three well-known indicators: the value at risk index (CoVaR), marginal expected shortfall index (MES) (M), and the systemic risk index (SRI). The study concluded that the use of Systemic Risk Scale (SRI) is a good tool for monitoring early warning signs of economic recession. Steffen (2012) believes that the possession of sovereign debt by the most exposed banks as a form of recapitalization after crises is a major contributor to the emergence of systemic risks, and the basic capital required to restore confidence in the banking sector is estimated at a rate higher than 9% of risk-weighted assets compared to 4% Prescribed under Basel II. Fang et al. (2017) analysed the systemic risk classification of the Chinese banking sector using the main principal component analysis (PCA), where he found that the systemic risk scale (SRISK) is the most reliable of the five-common metrics in predicting financial crises and dealing with them in advance. The study of Ekinci (2016) indicates that the existence of a strong relationship between economic growth and the performance of the banking sector makes it imperative for banks to understand the effects of market risks on their financial performance, thus improve the performance of the banking system as a whole. The study found a strong positive effect of the foreign exchange rate on the performance of the Turkish banking sector while the interest rate effect was weak. Teply and Kvapilikova (2017) through measuring the contribution of the US banking sector to the systemic risks of banks, concluded that the volatility, the size of the bank and the value at risk are the most powerful factors in determining the overall systemic risk. According to Ab-Hamid et al. (2018) large banks that may arise as a result of a merger can bear market risks from crises. Also, increased efficiency in cost and profits leads to an increase in market risks according to the return and risk relationship. Scannella and Polizzi (2018) provides evidence from European banks that banks differ in the degree of early reporting of market risks, although they are subject to the same regulatory requirements and standards. Tassew and Hailu (2019) showed that there is a negative and significant effect of market risks on the financial performance of banks in Ethiopia. Hedging against market risks requires an accurate estimation of the minimum capital requirements as well as an estimation of subsequent salvage costs to reduce systemic crises (Feinstein et al., 2017). Confirms Trenca et al. (2015) the effect of inflation on the liquidity of the banking system, as it is considered a major determinant of the liquidity level of 40 banks in Europe. According to Beck and De Jonghe (2013), sectoral specialization in bank lending increases the risk of exposure to systemic risks and leads to lower returns, and therefore diversification is considered a safe way to reduce systemic risks. Zhang and Li (2018) found that the exchange rates and oil prices are the most influential factors for the six Chinese banks working in carbon finance. Showed Fahrul and Rusliati (2016) that interest rates positively affect the profitability of 30 from Indonesian banks. Brunnermeier et al. (2012)'s study proved that commercial banks that depend on interest income (traditional activities such as taking deposits and lending) are less vulnerable to systemic risks than banks that rely heavily on income from investment activities and venture capital. Salem and Rahman (2016) tested the factors that affect the efficiency of banks in the Fertile Crescent countries during the Arab Spring revolutions; he found that the size of deposits and the size of assets affect the efficiency of banks, while the unstable economic and political conditions do not significantly affect the efficiency of banks. In Saudi Arabia, there are no studies that examined the effect of systemic risks on the stability of the banking sector. Therefore, this study is the first of its kind in Saudi Arabia. We found the study of Al-Hassan et al. (2010), which indicated that the great credit expansion in Gulf banks is directly related to the increase in oil prices, and it may represent a systematic risk that lies in the risks of credit concentration and fluctuations of liquidity in banks as a result of fluctuating oil prices.

3. Overview of Banking Industry in Saudi Arabia

Saudi banks operate in a competitive high-risk environment, which makes it imperative that they keep pace with global banking developments and adhere to the standards and requirements of the Basel Committee, which has been in place since 2008. In the past ten years, commercial banks have witnessed major developments in the growth of credit, the size of assets and bank deposits (Table 1 shows the most important of these developments), and they also had a pivotal role in supporting various economic activities (Arab Monetary Fund. 2019). Currently, There are 25 commercial banks (11 local banks and 13 foreign banks) operating in Saudi Arabia by the end of 2019, including branches of foreign banks, operate under the supervision of the Saudi Arabian Monetary Authority. Annual report showed an increase in banking activity during 2019, as the total assets of the banking sector increased by 9.7%, bank deposits increased by 7.3%, and its profits grew by 4.5% over the previous year. (SAMA, 2020);(SAMA, Report, Q1. 2020). The Saudi banking system enjoys many strengths points, the most important of which is the existence of conservative regulation and supervision of the banking system. The banking sector consists of a limited number of banks under the imposition of severe restrictions on entering the market. This gives banks protected customer privileges. Banks also receive their financing from large and relatively stable domestic customer deposits (S&P global, 2016).

Table 1: developments in banking activity in Saudi Arabia

Year	Number of banks	Number of Branches	Assets (million SR)		Deposits (million SR)	
			Total	% of GDP	Total	% of GDP
2011	23	1646	1568656	72.00	1119644	51.39
2012	23	1696	1759857	76.63	1274953	55.51
2013	23	1768	1921763	81.48	1417930	60.12
2014	23	1912	2162545	88.45	1588139	64.96
2015	23	1989	2233254	87.74	1617090	63.53
2016	25	2038	2289001	88.46	1629385	62.97
2017	25	2079	2350891	91.53	1633125	63.58
2018	25	2083	2398147	91.15	1673513	63.61
2019	26	2076	2631128	99.67	1795979	68.03
2020	27	2014	2979600	118.47	1942900	74

4. Methodology and findings

In present research, the Auto-Regressive Distributed Lags (ARDL) for Co- integration (bound test) is used, which enables the testing of the relationship between research variables in the short and long run, a Wald test has been used to define if there is a causality between variables, also the Cusum test was used to test the stability of the estimated relationship. It is important to ensure that the model is free from problem of Heteroskedasticity (Arch test), problem of Autocorrelation (Lagrange Multiplier test). E-views 9 program had used to estimate the model. The data includes two dependent variables and four independent variables. The time series for the variables were obtained from the annual reports of the Saudi Arabian Monetary Authority (SAMA) and the World Bank database, World Development Indicators (WDI) for the period (1984-2020).

4.1 Variables definition

Table 2: Definition of search variables

Symbol	Variable	Measurements	Source
Dependent variable			
ASSET	Banking Assets	Total Assets/ GDP	SAMA
DEP	Banking Deposits	Total Deposits/ GDP	SAMA
Independent variables			
OIL	Oil prices	Average annual price for the OPEC basket	SAMA
INF	Inflation	Consumer Price Index (CPI)	WDI
INT	Interest Rate	Interest rates on bank deposits	SAMA
POLi	Political instability	Yemen War as a dummy variable equal 1 if the year is 2015 to 2019 and 0 otherwise.	Author's calculation

The research variables include two dependent variables and four independent variables. POLi: Political instability is represented by the war with Yemen, as it is the most important geopolitical event in the region at present. It was measured using the dummy variable.

4.2 Model specification

The model used in this research is Auto-Regressive Distributed Lags (ARDL) that includes two dependent variable and four independent variables. The ARDL model is characterized by its strength against the Autocorrelation of the residuals so that the presence of the Autocorrelation problem does not affect the estimates, and it is also natural that there is a problem of Heteroskedasocity in this model that the variables are integrated of different degrees I(0) or I(1) (Shrestha & Chowdhury, 2005). The general form of the study can be formulated with the following equation:

$$\boldsymbol{ASSET_t = \propto + \beta_1 OIL_t + \beta_2 INF_t + \beta_3 INT_t + \beta_4 POLI_t + \varepsilon_t} \quad \dots\dots(\mathbf{1})$$

Where: ASSET is Banking Assets, OIL is Average annual price for the OPEC basket, INF is Inflation, INT is interest rate, POL.S is Political Stable. According to the previous theoretical basis, it is expected that all independent variables will have a positive effect on the stability of the banking sector in Saudi Arabia, with the exception of inflation, which may negatively affect the stability of the banking sector. From the previous model, the ARDL model can be formulated as follows:

$$\boldsymbol{ASSET_t = \propto_0 + \propto_1 DPOLI_t + \sum_{i=1}^{p} \beta_i ASSET_{t-i} + \sum_{i=0}^{q} \beta_i OIL_{t-i} + \sum_{i=0}^{q} \beta_i INF_{t-i}}$$
$$\boldsymbol{+ \sum_{i=0}^{q} \beta_i INT_{t-i} + \gamma_1 OIL_{t-1} + \gamma_2 INF_{t-1} + \gamma_3 INT_{t-1} + \varepsilon_t} \quad \dots(\mathbf{2})$$

From it, the error correction model (ECM) of the previous model can be obtained as follows, where the variables are in the case of differences (Pesaran et al., 2001).

$$\Delta ASSET_t = \propto_0 + \propto_1 DPOLI_t + \sum_{i=1}^{p} \beta_i \Delta ASSET_{t-i} + \sum_{i=1}^{q} \beta_i \Delta OIL_{t-i} + \sum_{i=1}^{q} \beta_i \Delta INF_{t-i} + \sum_{i=1}^{q} \beta_i \Delta INT_{t-i} + \hat{\rho}\, ECM + \varepsilon_t \quad \dots (3)$$

Where ρˆ represents the residuals from the long-run relationship estimation and is given by the following formula:

$$\gamma_0 ASSET_{t-1} = \gamma_1 + \gamma_2 OIL_{t-1} + \gamma_3 INF_{t-1} + \gamma_4 INT_{t-1} + \gamma_5 DPOLI_{t-1} \quad \dots (4-a)$$

$$(4-b)\ \hat{\rho} = ASSET_{t-1} - \left(\frac{\gamma_1}{\gamma_0} + \frac{\gamma_2}{\gamma_0} OIL_{T-1} + \frac{\gamma_3}{\gamma_0} INF_{t-1} + \frac{\gamma_4}{\gamma_0} INT_{t-1} + \frac{\gamma_5}{\gamma_0} DPOLI_{t-1} \right) \dots$$

The second equation will be valued in the same way with the other dependent variable is the total deposits (DEP) instead of the total assets (ASSET).

5. Result and Discussion

5.1 Unit Root Tests

Before application of the Co-integration methodology, it is necessary to identify the behaviour of the variables is it stable, using the Unit Root tests and table no. (3) shows the results of this test.

Table 3: Results of Stability tests using ADF and PP

Variable	At Level				At 1st Deference				Rank
	ADF		PP		ADF		PP		
	Trend and intercept	intercept	Trend and intercept	intercept	Trend and intercept	intercept	Trend and intercept	intercept	
ASSET	1.28	1.80	-1.34	1.46	-4.33*	-3.73	-4.11	-3.71	I(1)
DEP	-2.30	-1.45	-1.98	-1.69	-11.34*	-10.16	-10.39	-8.92	I(1)
OIL	-2.99	-1.80	-3.00	-1.80	-5.33*	-5.31	-5.30	-5.29	I(1)
INF	-2.29	-1.50	-1.83	0.44	-1.46	-2.04	-2.59	-2.81**	I(1)
INT	-4.18*	-2.07	-2.30	-2.20					I(0)
	Critical values				Critical values				
1%	-4.24	-3.63	-4.24	-3.63	-4.24	-3.63	-4.24	-3.63	
5%	-3.54	-2.94	-3.54	-2.94	-3.54	-2.94	-3.54	-2.94	
10%	-3.20	-2.61	-3.20	-2.61	-3.20	-2.61	-3.20	-2.61	

The results of unit root tests using Augmented Dickey–Fuller test and Phillips Perron test showed that the variables are not stable at the level, but they are stable at the first difference, that's means the variables are integrated at the first degree I(1) exept interest rate is integrated at level I(0). therefore we can test the existence of a long-run equilibrium relationship between the variables using the Auto-regressive (ARDL) bound test, which is characterized by the possibility of applying it when the variables are integrated at different degrees.

5.2 Determine the optimal number of lags

To determine the optimal lags length for the two study models, the Akike Info Criterion (AIC) is used, where the model is chosen in which the value of the criterion is the lowest. The following figures show that the two best models are ARDL(4,2,1,3,2) for model(1) and ARDL(4,0,4,4,0) for model (2).

5.3 Cointegration Test

The ARDL method can be applied to test the existence of a co-integration relationship between the variables (Pesaran et al., 2001) by performing the bound test of the null hypothesis:

$$\boldsymbol{H_0}:\ \boldsymbol{\beta_i} = \boldsymbol{\gamma_i} = \mathbf{0} \qquad \boldsymbol{i} = \mathbf{1}, \mathbf{2}, \mathbf{3}, \dots, \boldsymbol{K} + \mathbf{1}$$

Where the result of the bound test through the calculated value of F showed the existence of a co-integration relationship between the variables in the long-run in both models, as is evident from the following table:

Table 4: Results of Cointegration using Bound Test

Regressions	**lags**	**Sta. F**	**Result**
ASSET,OIL,INF,INT,POL.S	(4,2,1,3,2)	5.80	Co-integration
DEP,OIL,INF,INT,POL.S	(4,0,4,4,0)	4.52	Co-integration
Critical Value Bound		I(0)	I(1)
10%		2.45	3.52
5%		2.86	4.01
1%		3.74	5.06

The results showed through value of F statistic that there is a long-run equilibrium relationship in the two regressions, which indicates that there is a co-integral of the models to be tested. After confirming the existence of co-integration, it can estimate a short and long-run relationship between the variables according to equation No. (3). Where ASSET and DEP are the dependent variables. First, estimate long-run relationship according to the following formulation:

$$\boldsymbol{ASSET_{t-1}} = \boldsymbol{\gamma_1} + \boldsymbol{\gamma_2 OIL_{t-1}} + \boldsymbol{\gamma_3 INF_{t-1}} + \boldsymbol{\gamma_4 INT_{t-1}} + \boldsymbol{\gamma_5 DPOLI_{t-1}}$$

$$\boldsymbol{DEP_{t-1}} = \boldsymbol{\gamma_1} + \boldsymbol{\gamma_2 OIL_{t-1}} + \boldsymbol{\gamma_3 INF_{t-1}} + \boldsymbol{\gamma_4 INT_{t-1}} + \boldsymbol{\gamma_5 DPOLI_{t-1}}$$

Table 5: Result of long-run relationship

Variable	Model 1 (ASSET)		Model 2 (DEP)	
	Coefficients	**t-sta. (Prob)**	**Coefficients**	**t-sta. (Prob)**
OIL	0.5483	6.567	0.00023	-1.84**
		(0.000)		(0.086)
INF	0.4022	3.221	0.00062	1.51
		(0.005)		(0.152)
INT	-1.2568	-2.685	0.012	5.11
		(0.016)		(0.000)
POLI.	27.0639	7.510	-0.037	-1.95**
		(0.000)		(0.07)
C	-9.4836	-0.926	0.011	0.23
		(0.369)		(0.823)

**stable at 5% level   **stable at 10% level*

The results in both models indicate to a positive and significant impact of oil price changes on the total assets but the effect was small on the total deposits in Saudi Arabia. If oil prices change by 1%, it will lead to a change in total assets by 0,54%. The results in both models indicate a positive and significant effect of oil price changes on total assets, but the effect was small on total deposits in Saudi Arabia. If oil prices change by 1%, this will change total assets by 0.54%. Despite the decline in oil prices globally, the impact of oil prices remained positive on the performance indicators of the banking sector. This justifies that Saudi Arabia has an excess production capacity through which it can absorb shocks in oil prices. There is a positive and significant effect of inflation on total assets in the first model, while it slightly affects total deposits in the second model. Although this result contradicts the economic theory that acknowledges the existence of a negative impact of inflation on assets and debts, as it leads to erosion of their value over time, we can attribute this to the fact that Saudi Arabia enjoys relative stability in general prices as evidenced by the statistics published by the competent authorities, and thus low inflation rates and its lack of impact on banking assets and debt. Interest rates negatively affect total bank assets in the first model, while positively affecting total deposits, as the increase in interest rates paid on deposits means an increase in the demand for bank deposits as an opportunity cost. While it may negatively affect the bank's assets as a cost to the bank if it is greater than the interest collected from debt. The political stability in Saudi Arabia has been affected by the Yemen war since 2015, as the results indicate a negative impact of the Yemen war on the stability of the banking sector, as it led to a decrease in the volume of bank deposits during the war period, which may be attributed to the decline in the level of income due to many productive sectors are affected, the most important of which is the oil sector. In the next stage, estimated residuals in previous regression are used to estimate the error correction model (ECM) according to equation no. (4), which show the error correction parameter (ρ̀) in both models, the results shows in table (6).

Table 6: Results of Error Correction models

Variable	Model 1				model 2		
	Coefficient	t-Stat	Prob.	Variable	Coefficient	t-Stat	Prob.
D(ASSETS(-1))	0.826	2.570	0.021	D(DEP(-1))	0.122	0.757	0.461
D(ASSETS(-2))	1.053	2.859	0.012	D(DEP(-2))	0.020	0.149	0.883
D(ASSETS(-3))	0.345	1.415	0.178	D(DEP(-3))	-0.249	-1.995	0.065
D(OIL)	0.281	2.674	0.017	D(OIL)	0.000	-1.847	0.085
D(OIL(-1))	-0.134	-2.072	0.056	D(INF)	0.000	-0.374	0.714
D(INF)	-0.856	-2.924	0.011	D(INF)	0.001	0.496	0.627
D(INT)	-0.683	-1.302	0.213	D(INF)	0.002	1.756	0.100
D(INT(-1))	0.040	0.052	0.959	D(INF)	-0.002	-2.138	0.049
D(INT(-2))	0.662	1.303	0.212	D(INT)	0.003	1.752	0.100
D(POLI)	5.794	1.161	0.264	D(INT(-1))	-0.001	-0.622	0.543
D(POLI(-1))	-7.725	-1.876	0.080	D(INT(-2))	0.002	1.076	0.299
CointEq(-1)	-1.025	-2.973	0.010	D(INT(-3))	-0.004	-2.750	0.015
				D(POLI)	-0.018	-1.905	0.076
				CointEq(-1)	-0.500	-4.452	0.001

**stable at 5% level **stable at 10% level*

This model illustrates the dynamic behavior of the ARDL model, as it measures the effect of the current values of the independent variables and the past values of the dependent and independent variables on the dependent variable, and also shows the dynamic correlation between the long-run coefficients with the short-run coefficients. The results in the model (1) indicate that the total banking assets in the Saudi Arabia are affected by its previous values and the current and previous values of the explanatory variables. The results of the model (2) indicate that total deposits are not affected by its previous values, but affected by current and previous values of interest rates, oil prices and political instability during the years of war in Yemen. The results also indicate that the error correction parameter ECM_{t-1} fulfils the conditions indicating the existence of a valid co-integration relationship, as we found it a negative and significant value. The error correction parameter shows the speed of adjustment from the short-run relationship to the long-run relationship, as its value was -1.02 in Model 1, and this means that the distance from the equilibrium is corrected by about 102% of it every year as the data is annual, and the correction process takes about less than a year to reach long-run relationship. In model 2 the error correction parameter ECM_{t-1} equal -0.5, this means that the distance from the equilibrium is corrected by about 50% of it every year as the data is annual, and the correction process takes about two year to reach long-run relationship.

5.4 Models Examination Tests

Despite the strength of the ARDL model against autocorrelation and Heteroskedasocity problems as previously indicated, we find that model examination tests in Table (7) indicate that the model is free from measurement problems. The most important of these is the Lagrange Multiplier test, which indicates that there is no autocorrelation problem between the residuals estimated in the two models. The Arch test, which indicates there is no Heteroskedasocity problem. The Jarquo-Pera test, which indicates that the estimated residues follow a normal distribution. The R statistic indicates the high explanatory ability of the independent variables to explain the behavior of the dependent variable in both models. The Ramsy test also indicates the integrity of the first model structure used for estimation.

Table 7: Results of models examination tests

Test	**Model 1 (ASSET)**	**Model 2 (DEP)**
Adjust R^2	0.99	0.97
LM - F(2,13)	1.391 (0.283)	3.549 (0.058)
Normality JB	1.55 (0.459)	0.373 (0.829)
Heteroskedasocity, ARCH x_2^2	0.304 (0.858)	3.118 (0.210)
Ramsy-F(1,14)	0.953 (0.345)	8.655 (0.01)

**P-Values in parentheses.*

5.5 Wald Test

Abraham Wald (1945) presented two levels to find out the extent of causation between the economic variables for which a co- integration relationship was previously tested (Morley, 2006). The first test: the weak short-run causality test by subjecting all parameters of the Error Correction Model to the test except for error correction parameter ECM_{t-1}. The following null hypothesis is tested:

$$\boldsymbol{H_0}:\ \boldsymbol{\beta_1 = \beta_2 = \beta_3 = \cdots = \beta_i = 0}$$

The second test is a strong long-run causality, by subjecting all parameters of the Error Correction Model to the test with error correction parameter $\boldsymbol{\hat{\rho}}$ according to the following null hypothesis. In each of the previous tests we obtain the F statistic, if the null hypothesis is rejected, there is a causal relationship between the variables.

$$\boldsymbol{H_0}:\ \boldsymbol{\beta_i = \ \hat{\rho} = 0}$$

Table 8: Results of Wald Test, number of lags (2)

Test	**Model 1 (ASSET)**	**Model 2 (DEP)**
weak short-run causality	90.61 (0.000)	20.59 (0.000)

strong long -run causality	90.85 (0.000)	20.89 (0.000)

**P-Values in parentheses.*

The significance of the ECM parameters indicates the long-run causality in both models, which extends from the independent variables to the dependent variable. The results also indicate the existence of a causal relationship in the short-run, and this supports the long-run effect of the variables explaining the dependent variable.

5.6 Structural stability test for model coefficients

This test is used to monitor shifts and deviations in the average process over a period, and the extent of stability and consistency of long-run parameters with short-run parameters (Brown et al., 2011). The Cumulative Sum of Recursive Residual (CUSUM) is used to test the structural stability for the Unconstrained ARDL Model (UECM- ARDL), The structural stability of the estimated model parameters is achieved when the CUSUM statistic graph is confined within the critical graphic lines at the 5% level of significance. So, it may reveal any process that is out of control by drifting up or down cumulatively outside the critical values (Bahmani-oskooee et al., 2002); (Jahangard et al., 2017). The following figures show the test result of CUSUM in both models.

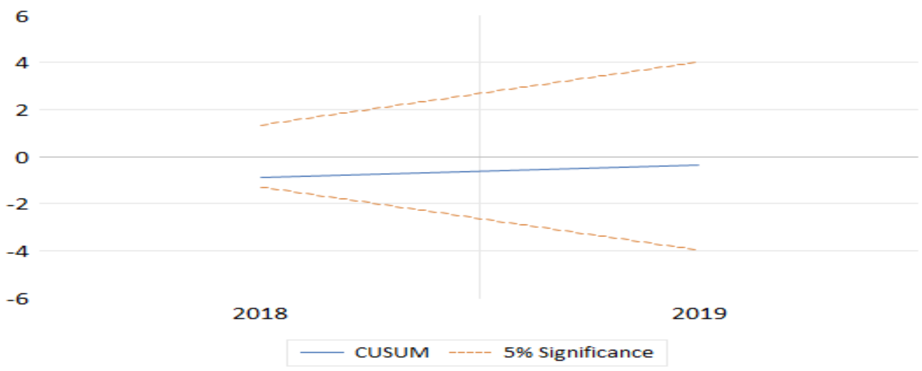

Figure 1: Plot of Cumulative Sum of Squares of Recursive Residuals for Model 1

It is evident from Figure (3) that the graph of the CUSUM statistic for Model 1 is located within the critical limits at the 5% level of significance, as it indicates that the estimated coefficients of the Unrestricted Error Correction Model (UECM) are structurally stable during the study period. In model 2, we notice that the CUSUM statistics diagram deviates from the critical values, and thus the instability of the coefficients of this model and their inconsistency with the long-run transactions. Therefore, we can say that Model 1 is the best representation of the relationship between systemic risk and the stability of the banking sector in Saudi Arabia. Also, this model is valid for predicting the future relationship.

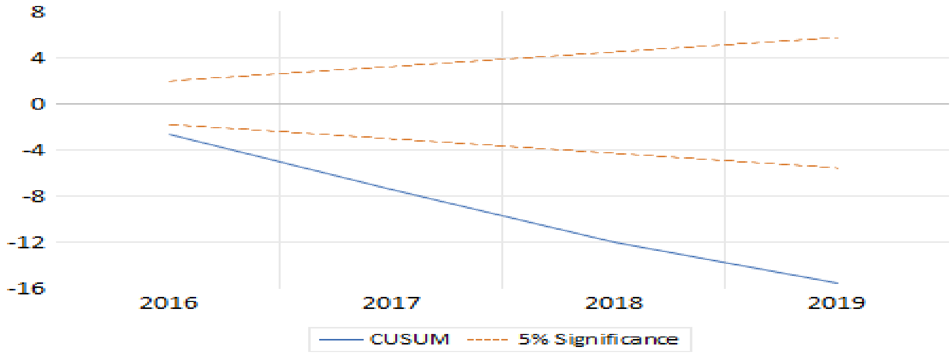

Figure 2: Plot of Cumulative Sum of Squares of Recursive Residuals for Model 2

6. Conclusion

The banking sectors are subjected to a lot of pressures due to geopolitical events that affected international oil prices and led to political instability in the Middle East. This study aimed to study the impact of these events as systemic risks affecting the entire market and thus on the stability of the banking sector in the Kingdom of Saudi Arabia during (1984-2020), using the ARDL approach of Co-integration and stability testing. In light of the economic theory and the literature that was revised, the conceptual framework for the study was defined, as the systemic risks include variables that affect the market as a whole, such as oil prices, inflation, interest rates and political instability, and then determine their impact on the stability of the banking sector represented by total assets and total deposits as a percentage of the Gross Domestic Product (GDP). The results showed a positive significant effect of oil prices and inflation on the total assets and total deposits of the banking sector. The interest rate has a negative effect on total assets while positively affects total deposits. The war in Yemen had a significant impact on the total assets of the banking sector during the period of the Yemen war, while there is insufficient evidence about its impact on total deposits. Wald's test indicates a causation that extends from the independent variables to the dependent variables in the long- run and short-run. This supports the long-run effect of the variables that explain the dependent variable. It is appear from the CUSUM test that the estimated coefficients of the UECM using total assets (dependent variable) are structurally stable and consistent with long-run parameters. Then, it can say that the first model is the best in representing of the relationship between systemic risk and the stability of the banking sector in Saudi Arabia, as it is suitable for predicting the relationship in the future.

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