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Abstract

This paper investigates the interaction between monetary policy and financial stability in the Gulf Cooperation Council (*hereafter* GCC) countries by introducing a new composite financial stability index to monitor the financial vulnerabilities and crisis periods. To this end, the study estimated monetary policy reaction functions for each of the GCC countries (namely, Bahrain, Kuwait, Saudi Arabia, and the United Arab Emirates) using the Nonlinear Autoregressive Distributed Lag Model (NARDL) over the period from 2006-Q4 to 2020-Q2. Empirical findings indicate that monetary authorities' response to the deviation of inflation from their target level, output gap, or exchange rate movement differ in terms of magnitude, sign, and significance across the GCC countries. The results further explain that monetary authorities react significantly to negative or positive shocks in financial stability, but their reaction is different in the short-run or long run. Overall, an augmented Taylor rule including financial stability as an additional monetary policy objective is more appropriate for the GCC countries.

Keywords: Financial stability; Monetary policy; Taylor rule; GCC countries.
JEL Classifications: C32, E44, E52, E58.

1. Introduction

Before the global financial crisis (*hereafter* GFC), the monetary policy prevailed consists of adjusting the interest rates only in response to inflation and (probably) output. The GFC and resultant slowdown in economic activities spurred economists to revisit monetary policy's efficacy. A monetary policy based on low-interest rates leads to excessive bank risk-taking and then affects financial stability (e.g., Jiménez et al., 2012; Valencia., 2014;' Dell'Ariccia et al., 2014; Ioannidou., 2015; Tong., 2017; *among others*). An expansionary monetary policy can cause an excessive increase in credit and asset prices and help create bubbles. The housing bubble and the mortgage market collapse during the GFC were caused by the monetary policy, which failed to preserve financial stability. The GFC demonstrates the importance of financial stability and represents the monetary policy's main actor (De Gregorio, 2010). The standard Taylor rule, using inflation and economic activity to approximate short-term interest rates, has lost substantial explanatory power in the wake of the GFC (Gross and Zahner; 2021). The debate on the interaction of monetary policy and financial stability has been intensive but without reaching a definite conclusion. According to Allen and Wood (2006), financial stability is perceived as a public good, and safeguarding financial stability may conflict with accomplishing other public policy goals. However, Oosterloo and Haan (2004) state that financial stability is one of the central banks' main functions, but heterogeneity in how the central banks execute the financial stability is explained by the insufficiency of a clear legal basis.

Financial stability is an essential concept that policymakers aim to achieve. According to Crockett (1997), financial stability refers to the stability of the prominent institutions and markets that make up the financial system. According to Driffill et al. (2006), researchers analyze financial stability based on its negative equivalent, financial instability, as it was more comfortable identifying financial instability situations and possible causes. Mishkin (1999) defines financial instability as a trouble to the financial system's efficiency in fund allocation, occurring when shocks to the financial system interfere with information flows. Financial instability occurs by the deterioration of financial sector balance sheets, increases in interest rates, increases in uncertainty, and the deterioration of non-financial balance sheets. Financial systems' troubles have demonstrated close linkages between financial stability and the real economy's health.

In this study, two facts have motivated us to examine and analyze the interaction between monetary stability and financial stability. The first fact relates to the impact of the COVID-19 shock on the global financial system. The outbreak of the coronavirus disease represents the biggest test of global financial stability since the GFC. The pandemic created a strong contagion effect across global financial markets, leading to an immediate economic downturn and unprecedented levels of economic uncertainty. Financial markets have witnessed a sharp decline in financial assets' prices, a deterioration in market liquidity, and volatility spikes (Gopinath, 2020). The sharp fall in oil prices combined with the negative impact of economic lockdown to counter COVID-19 impacted GCC countries' economic health, which adopted several monetary measures to tackle the impact of the COVID-19 pandemic.

Consequently, academic literature examining the responses of various financial assets and markets to the pandemic is rapidly emerging[4]. The COVID-19 pandemic renewed the debate about the interaction between monetary policy and financial stability. The monetary policy should significantly balance the global pandemic's macroeconomic and financial impacts global pandemic's macroeconomic and financial impacts and help create favorable conditions for the recovery. The second fact admits that there are no empirical studies in the GCC region that explain the interaction between monetary policy and financial stability. Thus, this study aims to analyze the interaction between monetary stability and financial stability in GCC countries by introducing a financial stability index to monitor the financial vulnerabilities and crises.

In this study, we make two core contributions to the existing literature. First, we develop a composite index of financial stability that provides a more comprehensive and complete view of GCC countries' financial conditions. Second, to the best of our knowledge, this is the first paper to investigate whether the monetary authority gives any attention to the financial stability in pursuing monetary policies in GCC economies. For this purpose, monetary policy reaction functions are estimated for each of the GCC countries, namely, Bahrain, Kuwait, Saudi Arabia, and the United Arab Emirates. Furthermore, our sample period covers some important economic and financial events (e.g., The 2008 global financial crisis, the 2014-2015 oil price pandemic) that impacted the GCC economies and led to monetary measures.

The remainder of the paper is organized as follows. Section 2 reviews the related literature. Section 3 presents the conceptual framework and data sources. Section 4 describes variables construction and research methodology. Section 5 presents and discusses the empirical results. Section 6 concludes the paper.

2. Literature review

Monetary policy and financial stability follow a complicated and conflicting relationship over time. An enormous body of literature has tried to observe these dynamics, but the outcomes remain inconclusive. Financial stability can impact the monetary policy through several channels, including the credit market, the exchange rate, stock markets, and money supply[5]. Borio and Lowe (2004) examined the financial stability and monetary policy reactions in four advanced economies, namely Australia, Japan, the USA, and Germany, based on Modified Taylor rule functions. They found either negative or ambiguous results for all countries except the USA. Driffill et al. (2006)

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[4] (e.g., Akhtaruzzaman et al., 2020; Corbet et al., 2020; Demir et al., 2020; Goodell and Goutte, 2020; Liu et al., 2020; Sharif et al., 2020; Yarovaya et al., 2020; Yarovaya et al., 2021 ; Zhang et al., 2020; among others)

[5] For an extended explanation see Käfer (2014) and Gross and Zahner (2021)

investigate the financial institutions' use of futures and other derivatives markets to hedge against different risks. Banks' extensive use of hedging reduces their exposure to interest rate fluctuations and enables central banks to change interest rates. The authors find that basis risk (residual risk) implied by financial institutions' hedging strategies is a crucial component of a monetary policy intended at attaining financial stability. Taylor (2007) noted that the short-term interest rate path had deviated considerably between 2002 and 2005 from the observed short-term interest rates of the Great Moderation period. Markedly, low-interest rates had prompted financial institutions to over-leverage to reap high returns on risk capital. De Graeve et al. (2008) measure financial stability at the bank level as the probability of distress and integrate a microeconomic hazard model for bank distress with a standard macroeconomic model. Using data from the German banking sector and macro data between 1995 and 2004, they find the existence of a trade-off between monetary and financial stability, suggesting that an unexpected tightening of monetary policy raises the mean probability of distress. Granville and Mallick (2009) study the linkage and the procyclicality between monetary and financial stability. The authors examine the dynamic effects of inflation shocks on share prices, interest rate spreads, and financial stability. Using quarterly data from 1994:Q1 to 2008:Q2 for the euro area, they find a procyclicality between monetary and financial stability in the long run. This long-run relationship suggests that monetary stability is an essential precondition for financial stability. Also, the use of interest rates for inflation targeting is conducive to financial stability.

A growing body of research investigates the interaction between monetary policy and financial stability during the GFC. Albulescu et al. (2013) assess the impact of financial instability signals on the European Central banks' monetary policy decisions. They find that financial and banking instability has a negative influence on the determination of the interest rate. In the same vein, Peek et al. (2016) study the interaction between financial stability and monetary policy in the United States. They presented a simple model including the financial instability in the utility function for monetary policy. They find that financial stability should be an important player in the monetary policy. Camlica (2016) investigate the responsiveness of the central bank of Turkey to financial distress using the composite index of systemic stress. The author finds that the central bank of Turkey's response to systemic financial stress has changed after 2010 focusing more on financial stress. The bank developed unconventional policy tools such as reserve requirements and the monetary policy corridor. Tobal and Menna (2020) examine monetary policy's ability to reduce crisis probability by "leaning against the wind." They find that the relationship between financial stability and monetary policy in emerging market economies is different from the advanced economies because the financial conditions are strongly dependent on capital flows. More recently, Gross and Zahner (2021) apply a Bayesian model averaging approach for the interest rate setting to explain the European Central Bank's monetary policy before and during the GFC. They find that inflation is the primary driver of monetary policy decisions in the post-crisis period. For the pre-crisis period, the Taylor principle is rejected, and the economic activity measures are the main driver of the European Central Bank's monetary policy.

As can be inferred from the above literature, the outcomes of the recent empirical studies remain inconclusive. Also, empirical evidence therein is inconclusive and inconsistent. More importantly, no previous study investigated the interaction between financial stability and monetary policy in GCC economies. This study is the first to analyze the relationship and interaction between monetary stability and financial stability in GCC countries to the best of our knowledge. As such, it fills a fundamental gap in the literature.

3. Model specification and data sources

3.1. Model specification

The well-known monetary policy rule was suggested by Taylor (1993). The Federal funds rate is determined by two factors, namely the inflation gap and the output gap. Hence, the monetary policy rule is written as follows:

$$r_t = p_t + 0.5y_t + 0.5(p_t - 2) + 2 \qquad \textbf{(1)}$$

Where r_t is the monetary policy rate, p_t measures inflation rate over the next four quarters and y_t represents the deviation of real output from its target. Taylor (1999) modified the rule mentioned above by adding two additional variables, namely, the target rate of inflation (π^*) and equilibrium real interest rate (r_t^f) as presented below:

$$r_t = \pi_t + \theta y_t + \delta(\pi_t - \pi^*) + r_t^f \qquad \textbf{(2)}$$

This formulation ignored the effects of the exchange rate on monetary policy rule and criticized it extensively. The augmented Taylor rule specification used by later studies such as Ball (1999); Svensson (2000); and Ghosh et al. (2016) is shown as:

$$r_t = \delta\pi_t + \theta y_t + \gamma_1 ex_t + \gamma_2 ex_{t-1} \qquad \textbf{(3)}$$

The absence of intercept term in Eq. (3) indicates that the targeted inflation rate (π^*) is zero and interest rates (r_t) and exchange rates (ex_t) are measured relative to their long-run values (Taylor, 2001).

Following Ghosh et al. (2016) and Caporale et al. (2018), the variable of financial stability is added in augmented Taylor rule because financial crises have changed monetary policy's objective. Now, financial stability emerged as an additional objective of monetary policy. Therefore, the Taylor rule equation that is estimated in the current study can be written as:

$$r_t = \alpha_0 + \alpha_1 r_{t-1} + \alpha_2 \sum_{k=1}^{4}(E\pi_{t+k} - \pi^*) + \alpha_3 y_t + \alpha_4 ex_t + \alpha_5 fsi_t + \varepsilon_t \qquad \textbf{(4)}$$

Where r_{t-1} is the lagged short-term money market rate since policy rates are adjusted slowly, inflation gap is estimated as the difference between the expected inflation rate over the next four quarters ($E\pi_{t+k}$) and the inflation target rate (π^*) whereas the output gap is calculated by the deviation of the natural logarithm of real GDP from the potential GDP. Following the literature, both inflation targeting rate and potential output are obtained from a rolling Hodrick-Prescott filter (HP filter). Furthermore, ex_t and fsi_t denote the natural logarithm of real effective exchange rate and financial stability index, respectively.

3.2. Data sources

The quarterly time series data on four GCC countries, namely, Bahrain, Kuwait, Saudi Arabia, and the United Arab Emirates, are used in the present study over 2006-Q4 to 2020-Q2. The selection of sample countries is based on the availability of data. The data on financial stability indicators, short-term money market rate[6], inflation rate, real GDP, and real effective exchange rate are taken from the International Financial Statistics database and Thomson Reuters DataStream. The period covered in this study is susceptible because it covers several significant events such as 2008 global financial turmoils; 2011 Syrian civil war; drop in oil prices from mid of 2014 to the start of 2015 and end of 2015 to the beginning of 2016; 2017 Qatar diplomatic crisis and 2019 COVID-19 pandemic.

4. Construction of financial stability indices and econometric methodology

4.1. Construction of financial stability indices

Following the financial stability/stress literature (e.g., Kaminsky and Reinhart, 2003; Illing and Liu, 2003; Van den End, 2006; Albulescu, 2011; Albulescu et al., 2013; Elsayed & Yarovaya, 2019; Nasreen and Anwar, 2019; Ishrakieh et al., 2020; Gafrej and Abbes 2020), a set of financial variables are used to construct an aggregated composite index of Financial Stability (FSI) for each country. FSI is built by following Balakrishnan et al. (2011) and composed of four financial sectors: banking sector, equity market, bonds market, and foreign exchange market. The detail of indicators that measure these sectors is provided below:

4.1.1. Banking sector

Banking sector beta (βs)

The beta coefficient is derived from the standard Capital Asset Pricing Model (CAPM) and used to capture the industrial sector's systematic risk. For instance, banking sector beta (βs) measures the total risk associated with that sector (Perold, 2004). In recent years, it is used as a component of the financial stability index to compute the cost of equity and measure financial stress levels (Ishrakieh et al., 2020). The variation βs has been studied by King et al. (2009), Caporale (2012),

[6] A proxy for short term interest rate

Ishrakieh et al. (2020), and Gafrej and Abbes (2020). βs measure the percentage change in the banking sector index due to a 1 percent change in market return. A coefficient $\beta s = 1$ means the variation in banking sector returns and market returns follow the same trend. $\beta s > 1$ indicates that the banking sector returns are higher than overall market returns. It implies that the banking sector is at risk and associated with a higher likelihood of banking crisis. βs can be computed by using the following formula:

$$\beta s = \frac{\text{cov}(\pi^m, \pi^b)}{\sigma^2 m} \quad (5)$$

Where π^m *and* π^b represent month over month market and banking sector returns. $\sigma^2 m$ explains the variation in market returns.

Bank equities return (BRs)

Following the literature, we have used the negative quarterly bank returns (returns multiplied by minus one). A decline in bank returns corresponds to higher financial instability in the banking sector (Balakrishnan et al., 2011; Duca and Peltonen, 2013; Elsayed & Yarovaya, 2019).

Bank volatility (SRv)

Bank volatility represents financial uncertainty, and a GARCH (1,1) specification is used to capture the uncertainty in the banking sector.

4.1.2. Equity market

Stock market returns (SRs)

Stock market returns are computed as the quarter-on-quarter change in stock index multiplied by minus one. A decline in stock prices corresponds to increased equity market-related stress.

Stock market volatility (SRv)

The volatility in the stock market index arises during periods of uncertainty. In the construction of FSI, the time-varying conditional volatility computed from GARCH specification is included to detect periods of high volatility, which implies more increased instability.

4.1.3. Bond market

Sovereign spreads (SS)

Sovereign Spreads measured the difference between long-term and short-term security yields and became hostile when the short-term yield is greater than the long-term yield. A negative SS is employed to predict an economic recession shortly (Chinn and Kucko, 2015). Besides measuring economic recession, the negative sovereign spread is most widely used to measure bond market risks (Buch et al., 2014; Busch and Memmel, 2017; Gafrej and Abbes, 2020).

4.1.4. Foreign exchange market

Exchange Market Pressure Index (EMPI)

The exchange market is considered an essential sector in pertaining stability because a more volatile exchange rate decreases investors' confidence and might cause over-reaction, leading to financial instability (Ishrakieh et al., 2020). In the current study, following (Kamin et al., 2007; Moore and Wang, 2009; Balakrishnan et al., 2011 and Sahoo, 2020), we have used EMPI to measure currency risk. A high value of EMPI indicates that the exchange rate market is under pressure, which would raise the financial instability and vice versa.

The following formula calculates the EMPI for month t:

$$EMPI_t = \frac{(\Delta e_t - \mu_{\Delta e})}{\sigma_{\Delta e}} - \frac{(\Delta RES_t - \mu_{\Delta RES})}{\sigma_{\Delta RES}} \quad (6)$$

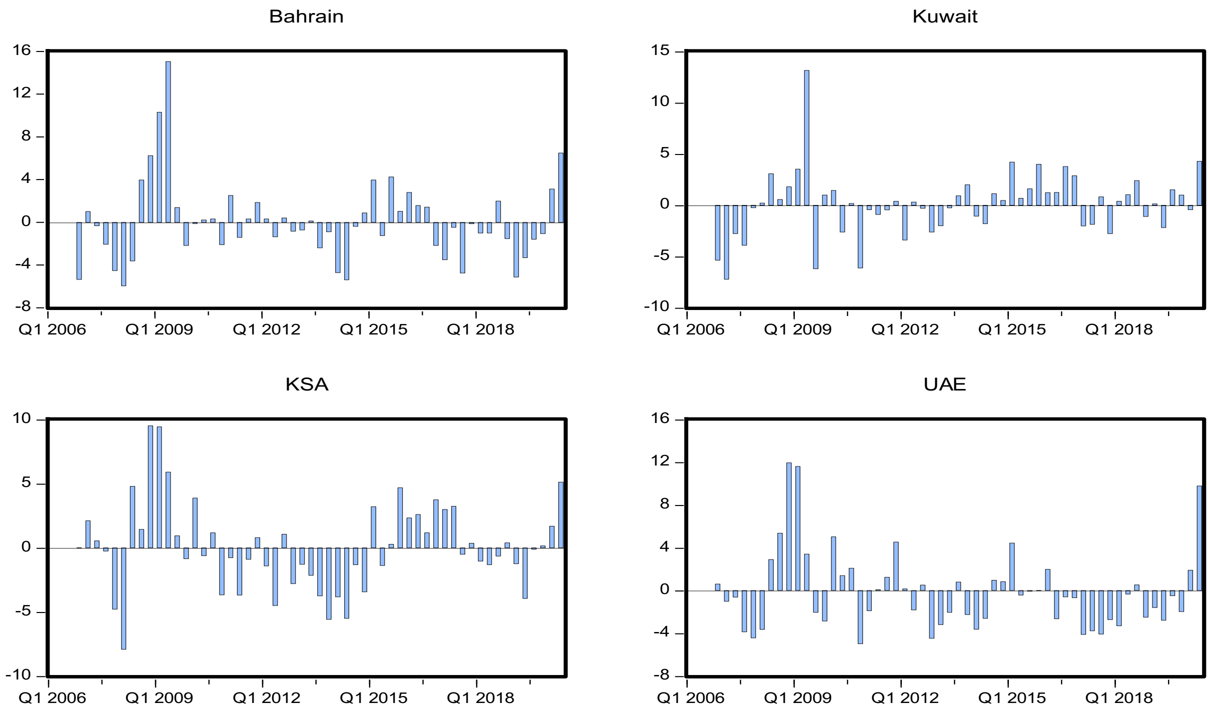
Where Δe_t and ΔRES_t are the month over month variation in the domestic exchange rate against the US dollar and the total reserves minus gold, respectively. Furthermore, μ and σ are the mean and standard deviation of the relevant series, respectively.

Finally, a variance-equal-weighting method is used for the construction of FSI. The advantage of this method is that it is easy to calculate and simple to interpret. According to this methodology, each indicator is first demeaned and then normalized by its standard deviation and finally added together to construct the index. The main feature of FSI is that it covers a broad array of financial indicators and segments. Hence, FSIs provide valuable information on the country's financial system condition compared with individual indicators due to its ability to capture different risks and financial instability sources.

Using the four sectors described above, FSI is constructed for each selected GCC country by adding the seven standardized indicators, each having equal weight (see Fig. 1). Positive values of the index indicate stress periods, while negative values indicate calm periods. It is clear from Fig.

1 that FSI responds to significant events and turbulences such as the global financial crisis 2008-2009, political conflict between Qatar and other GCC economies, and the recent COVID-19 pandemic.

Figure 1: FSI for GCC countries



4.2. Empirical Method

A large body of empirical studies confirms nonlinearities in central banks' reaction function (e.g., Taylor and Davradakis, 2006; Martin and Milas, 2013). Therefore, to capture the nonlinearities in central banks' monetary policy function, we have applied the Nonlinear Autoregressive Distributed Lag (NARDL) model proposed by Shin et al. (2014). The NARDL model can be written as:

$$r_t = \sum_{k=1}^{p} \varphi_k r_{t-k} + \sum_{k=0}^{q} \left(\vartheta_k^{+'} x_{t-k}^{+} + \vartheta_k^{-'} x_{t-k}^{-} \right) + \nu_t \qquad (7)$$

Where $x_t = [\pi_t, y_t, ex_t, fsi_t]$ defined such, that $x_t = x_0 + x_t^{+} + x_t^{-}$, φ_k is the autoregressive coefficient, ϑ_k^{+} and ϑ_k^{-} are the asymmetrically distributed lag coefficients and ν_t is normally distributed error term. x_t is decomposed around a zero threshold, thus, allowing us to distinguish between the effects of positive and negative shocks x_t.

Following Pesaran et al. (2001), the Error Correction specification of Eq. (7) can be written as:

$$\Delta i_t = \varpi + \rho_r i_{t-1} + \rho_\pi \pi_{t-1} + \rho_y y_{t-1} + \rho_{ex} ex_{t-1} + \rho_{fsi}^{+} fsi_{t-1}^{+} + \rho_{fsi}^{-} fsi_{t-1}^{-} + \sum_{j=1}^{p-1} \theta_j \Delta i_{t-k}$$

$$+ \sum_{k=0}^{q-1} \beta_k \Delta \pi_{t-k} + \sum_{k=0}^{q-1} \vartheta_k \Delta y_{t-k} + \sum_{k=0}^{q-1} \tau_k \Delta ex_{t-k} + \sum_{k=0}^{q-1} \left(\phi_k^{+} \Delta fsi_{t-k}^{+} + \phi_k^{-} \Delta fsi_{t-k}^{-} \right) + \varepsilon_t \qquad (8)$$

Where Δ is the first difference operator and ε_t is the error term. Moreover, fsi_t^{+} and fsi_t^{-} are the partial sum of positive and negative shocks in FSI and shown as follows:

$$fsi_t^{+} = \sum_{k=1}^{t} \Delta fsi_k^{+} = \sum_{k=1}^{t} \max(\Delta fsi_k, 0) \text{ and } fsi_t^{-} = \sum_{k=1}^{t} \Delta fsi_k^{-} = \sum_{k=1}^{t} \min(\Delta fsi_k, 0)$$

5. Empirical findings and discussion

One of the key advantages of the NARDL is that it allows us to model both short-run and long-run relationships between variables that have a mixed order of integration, which are I(0) and I(1). In other words, none of the variables is integrated into order 2. Thus, we perform two unit root tests, namely the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP), to confirm the order of integration of the chosen variables (see Table 1). The estimates of the ADF test indicate that the null hypothesis of unit root is accepted for a number of series (e.g., the output gap (y) in Bahrain, short term interest rate (r), inflation gap (π) and FSI (fsi) in Saudi Arabia, short term money market rate (i) in Kuwait, inflation gap (π), output gap (y) and exchange rate (ex) in UAE). The remaining series are reported to be level stationery. However, all series are found to be stationary at first difference.

Similarly, PP's estimates explain that most of the series are non-stationary except FSI (fsi) in all GCC countries, the output gap (y) in Bahrain, the short-term money market rate (i), and Kuwait's exchange rate. Overall, both unit root tests' statistics have reported the mixed order of integration for selected series. Hence, the NARDL technique is the most suitable to estimate the nonlinearities in the monetary policy reaction function.

Table 1. Unit root tests

	ADF					PP				
	i	π	y	ex	fs	i	π	y	ex	fs
Panel (A): Levels										
Bahrain	-4.84***	-4.52***	-3.04	-3.53**	-3.92***	-2.63	-1.82	-3.04**	-2.84	-4.01***
KSA	-2.11	-0.13	-3.16**	-3.05**	-2.82	-2.08	-2.10	-2.50	-2.58	-4.18***
Kuwait	-1.00	-3.55**	-3.79***	-3.57***	-6.42***	-3.53**	-2.51	-2.45	-3.39**	-6.43***
UAE	-3.35**	-2.25	-2.78	-2.57	-3.27**	-2.28	-2.43	-2.89	-2.47	-2.96**
Panel (B): Fist Diff.										
Bahrain	-5.24***	-3.76***	-7.20***	-4.38***	-8.37***	-5.14***	-2.97**	-7.20***	-4.69***	-8.61***
KSA	-6.70***	-4.12***	-5.27***	-6.12***	-10.93***	-6.67***	-2.96**	-4.86***	-5.93***	-11.92***
Kuwait	-3.75***	-4.26***	-7.36***	-5.70***	-3.62***	-7.18***	-3.23**	-7.40***	-7.59***	-16.48***
UAE	-3.97***	-3.85***	-7.92***	-4.98***	-5.62***	-4.02***	-2.93**	-7.93***	-4.71***	-7.88***

Note: $i, \pi, y, ex, and\ fs$ indicate short-run money market rate, inflation gap, output gap, and financial stress, respectively. ADF and PP represent the Augmented Dickey-Fuller and Phillips-Perron unit root tests with a constant term where the lag length is determined by the Akaike Information Criterion (AIC).

The second step consists of testing for the asymmetric long-run relationship (cointegration) among variables under consideration. Using the bounds cointegration test developed by Pesaran et al. (2001), the Bounds cointegration test findings for the NARDL model are presented in Table 2. The outcomes confirm that cointegration exists among selected series at 1% significance level in all GCC countries over 2006-Q4 to 2020-Q2.

Table 2. Bounds cointegration tests for NARDL models

Country	F-statistics	Lower-bound (95%)	Upper-bound (95%)	Lower-bound (99%)	Upper-bound (99%)	Conclusion
Bahrain	17.214***	2.67	3.78	3.59	4.98	Cointegration
KSA	5.094***	2.67	3.78	3.59	4.98	Cointegration
Kuwait	9.639***	2.67	3.78	3.59	4.98	Cointegration
UAE	5.584***	2.67	3.78	3.59	4.98	Cointegration

Note: This table presents the results of the Bounds cointegration tests. For the NARDL models, the dependent variables are the short-run money market rates. The null hypothesis to be tested is the absence of cointegration. *** shows significance at the 1% level.

Consequently, the short-term and long-term estimates of NARDL are demonstrated in Table 3. In Bahrain and Kuwait, the numerical estimates explain that the short-term money market rate responds positively to the inflation gap, output gap, and exchange rate. The outcome further explains that any positive shock to FSI enhances the short-term money market rate in the short-run in Bahrain, while any negative shock to FSI reduces Kuwait's short-term money market. Panel B describes the long-run findings of NARDL. The outcome explains that the inflation gap is positively and significantly associated with the short-term market rate in the long run. The evidence is in line with theoretical prediction and supports the findings of Kaytanci (2008) for Turkey; Caporale et al. (2018) for Indonesia, Israel, Thailand, and Turkey; Nasreen and Anwar (2019) for Bangladesh, Nepal, and Sri Lanka. These studies' evidence implies that central banks respond to inflationary pressure by increasing the nominal interest rate.

In terms of the output gap's coefficient, it is reported to be positive and significant in the case of KSA but insignificant for Bahrain, Kuwait, and UAE. This evidence indicates that monetary policy in KSA responds positively to changes in the output gap which is in line with the Taylor rule as well as prior empirical literature (e.g., Jawadi et al., 2014; Nasreen and Anwar, 2019; among others). The negative and significant exchange rate coefficient implies that when a large deviation is observed in the foreign exchange market, Bahrain and Kuwait's central bank intervene in the market to smooth out volatility (Daude et al., 2016). The asymmetric results of FSI in Bahrain imply that the interest rate responds insignificantly when financial stress increases but responds negatively and significantly in the presence of a financially stable environment. For instance, a 1% decrease in financial pressure reduces the short-term interest rate by 0.18%. That is, the central bank announces an expansionary monetary policy to decrease the level of financial stress. The outcome is consistent with the studies of Borio and Lowe (2004); De Grauwe and Gros (2009). Similarly, in Kuwait's case, the short-term interest rate responds negatively either financial stress increases shocks in financial stability adverse shocks in FSI are observed.

The short-term evidence in Saudi Arabia demonstrates that the central bank follows expansionary monetary policy in the short run to fulfill the output gap, inflation gap, and exchange rate gap. Also, the short-term interest rate responds negatively to a positive shock in FSI in the short run. It implies that the monetary authorities of Saudi Arabia expand the money supply during the period of stress. The long-run results presented in Table B explain the insignificant response of interest rate to the inflation gap in Saudi Arabia. The positive and significant output gap implies that the central bank should increase the short-term interest rate or contract money supply when the actual output is greater than the potential output. Also, the monetary authorities of Saudi Arabia need to take action when the exchange rate deviates from its target. When a currency depreciates more than the monetary authorities' target, the central bank may tighten monetary policy to ensure price stability and vice versa (Gagnon and Ihrig, 2004; Ghosh et al., 2016; Caporale et al. 2018).

Furthermore, the short-term interest rate's response is insignificant in periods of financial stress or financial stability. In the UAE, a financially stable market puts pressure on the short-term interest rate in the short run. The central bank of UAE adopts an expansionary monetary policy to fulfill out the gap and inflation gap in the long run. The central bank policy remains the same, i.g. expansionary monetary policy is formulated in periods of financial stress or financial stability. This outcome corroborates the findings of Cecchetti and Li (2008); Nasreen and Anwar (2019). These studies highlighted that the central bank's primary objective is to control inflation. Therefore, the bank faces a trade-off between her primary objective and the objective of financial stability. Overall, the findings suggest that the sign, significance, and magnitude of Taylor rule coefficients vary across GCC countries, which may be due to differences in country-specific characteristics.

Finally, in Panel C several diagnostic tests have been applied. The overall goodness of fit ($\bar{R}^2$) is more than 91%. The ECT value coefficient is negative and significant at 1% in all GCC countries and demonstrates the convergence of variables towards the long-term equilibrium path. The model residuals are uncorrelated, homoscedastic, and stable (please see Fig.A enlisted in Appendix 1). The dynamic multiplier graph explains the dynamic asymmetric adjustment in short-term interest rate towards long-run equilibrium path due to a unit shock (positive or negative) affecting financial stability (see Appendix 2 for further information). These multipliers are estimated based on the NARDL specification shown in Table 3. The negative (solid black line) and positive (black dotted line) change curves explain the dynamic adjustment due to negative and positive shocks at a given forecast horizon. The asymmetric curve is plotted at a 95% confidence interval demonstrates the linear combination of the dynamic multipliers associated with negative and positive shocks. The estimated dynamic multipliers illustrate the different pass-through mechanism from financial stability to short term money market rate in GCC countries.

Table 3. NARDL model estimates and diagnostic tests

Dependent variable: short term money market rate

	Bahrain		KSA		Kuwait		UAE	
	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.
Panel A: Short-run estimates								
c	-1.193***	0.000	0.166	0.547	0.613**	0.010	0.945***	0.000
i_{t-1}	-0.289***	0.000	-0.198***	0.005	-0.201***	0.002	-0.199***	0.000
π_{t-1}	0.1471**	0.010	0.005	0.905	0.296***	0.001	-0.083***	0.002
y_{t-1}	-4.858	0.102	5.865***	0.000	-1.331**	0.020	-1.555*	0.058
ex_{t-1}	-12.77**	0.040	17.54***	0.000	-6.974	0.142	0.569	0.662
fs^{+}_{t-1}	-0.024	0.316	0.041	0.314	-0.121***	0.000	-0.056***	0.002
fs^{-}_{t-1}	-0.052**	0.035	0.036	0.356	-0.134***	0.000	-0.047***	0.008
Δi_{t-1}	-0.610***	0.000			-0.342***	0.007		
Δi_{t-2}	-0.376***	0.001			-0.671***	0.000		
Δi_{t-3}	-0.395***	0.003						
$\Delta\pi$	0.311**	0.049	-0.121*	0.059	1.112***	0.000		
$\Delta\pi_{t-1}$	-0.547***	0.004			-0.521	0.148	-0.028	0.852
$\Delta\pi_{t-2}$					-0.939***	0.003	0.107	0.525
$\Delta\pi_{t-3}$							0.354**	0.045
Δy	8.132***	0.000	-0.343	0.751			-0.353	0.635
Δy_{t-1}	11.095***	0.000	-2.878**	0.020			0.949	0.129
Δy_{t-2}	9.693***	0.000						
Δy_{t-3}	5.405***	0.000						
Δex	2.107	0.547	11.242**	0.012	1.038s	0.766		
Δex_{t-1}	10.182**	0.039	-5.741	0.199	8.020**	0.016		
Δex_{t-2}	10.536***	0.004	-11.335***	0.000				
Δex_{t-3}	6.413*	0.055						
Δfs^{+}	0.002	0.913	-0.079***	0.009				
Δfs^{+}_{t-1}	0.048*	0.099	-0.093***	0.006				
Δfs^{+}_{t-2}	0.132***	0.000						
Δfs^{+}_{t-3}	0.075**	0.017						
Δfs^{-}			-0.034	0.443	-0.032*	0.093	-0.001	0.981
Δfs^{-}_{t-1}			-0.056	0.192	0.035*	0.051	0.069***	0.003
Δfs^{-}_{t-2}							0.083***	0.000
Δfs^{-}_{t-3}							0.044**	0.014
Panel B: Long-run estimates								
π	0.507**	0.015	0.027	0.903	1.465***	0.000	-0.421***	0.001
y	-16.752	0.160	29.608***	0.001	-6.592*	0.087	-7.812*	0.085
ex	-44.065*	0.083	88.590**	0.021	-34.531	0.206	2.861	0.659
fs^{+}	-0.084	0.308	0.208	0.226	-0.602**	0.013	-0.284***	0.004
fs^{-}	-0.179**	0.036	0.186	0.271	-0.665**	0.012	-0.237**	0.015
Panel C: Diagnostic test								
$\bar{R}^2$	0.966		0.922		0.913		0.956	
Ect_{t-1}	-0.289***		-0.198***		-0.201***		-0.199***	
LM test	3.677		3.177		1.785		0.603	
BPG test	30.225		14.266		14.598		19.501	
CUSUM	Stable		Stable		Stable		Stable	
CUSUMQ	Stable		Stable		Stable		Unstable	

Note: ETC is the error correction term; LM test refers to the Lagrange multiplier test for serial correlation; PBG test denotes the Breusch-Pagan-Godfrey Test for heteroscedasticity. CUSUM and CUSUMQ give the stability of short-run and long-run coefficients. Finally, the Optimal ARDL lag is determined based on Akaike Information Criterion (AIC). ***, **, and * indicate significance at the 1%, 5%, and 10% significant level respectively.

6. Concluding Remarks

This research examines the connection between monetary policy and financial stability in four GCC countries, namely, Bahrain, Kuwait, Saudi Arabia, and the United Arab Emirates, using quarterly data over 2006-Q4 to 2020-Q2. A composite financial stability index is constructed for each GCC country to examine the financial stress and vulnerability periods. Moreover, Taylor's rule specification has been augmented by considering the financial stability index as an additional variable. To this end, the NARDL technique has been applied to examine the asymmetric link between financial stability and short-term money market rate in GCC economies. The empirical findings indicate that monetary authorities respond to the deviation of inflation from its target level in all GCC countries except in Saudi Arabia. Secondly, the monetary authorities of Saudi Arabia react significantly to the output gap, while the responses of monetary authorities of Bahrain, Kuwait, and UAE are found to be insignificant. Third, only the monetary authorities of Bahrain and Saudi Arabia give due consideration to the real exchange rate movement in formulating monetary policy. Fouth, monetary authorities' response to positive and negative shocks in financial stability is different in the short-term and long-term. The positive shock in financial stability has a more significant effect on the short-term money market rate in the short run in Bahrain and Saudi Arabia. However, the adverse effect is observed in the long run in these countries. Similarly, in Kuwait and UAE, monetary authorities' response to negative shock in financial stability is found to be more significant in the short run. The monetary authorities respond to both negative and positive shocks in Kuwait and UAE's financial stability in the long run. These results show that only Kuwait, UAE, and Bahrain consider financial stability one of their monetary policy's key objectives.

The differences in monetary policy response in GCC countries may be due to several factors, including the differences in economic performance, the vulnerability to external and internal shocks, and differences in financialization and liberalization policies. Moreover, monetary authorities' response to positive or negative financial shocks suggests that the traditional linear Taylor rule is not appropriate for GCC countries due to the threat of financial crisis and external shocks to the monetary system. Therefore, GCC countries' monetary authorities should incorporate financial stability as an additional objective of their monetary policy.

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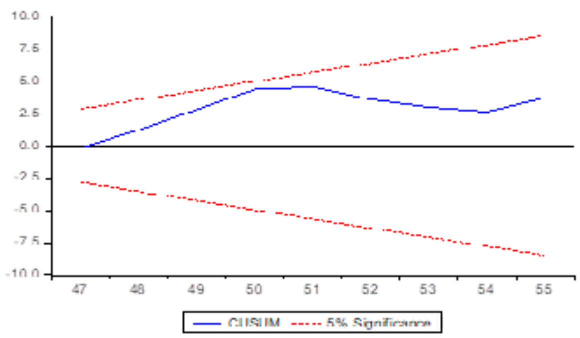
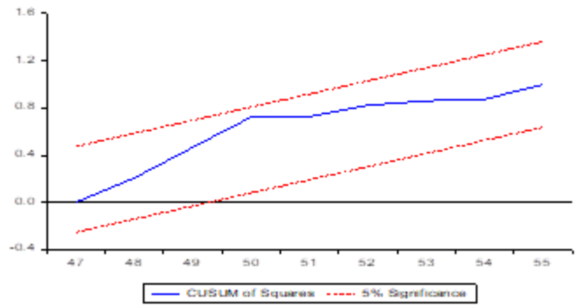
Appendix 1

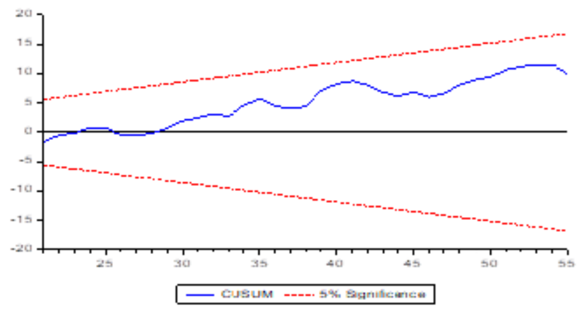
Figure A: CUSUM and CUSUMSQ parameter stability test for each country

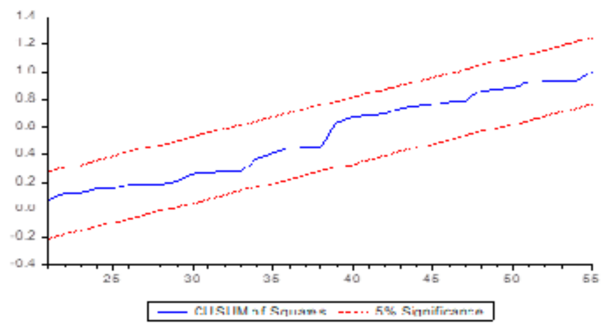
Bahrain





Saudi Arabia





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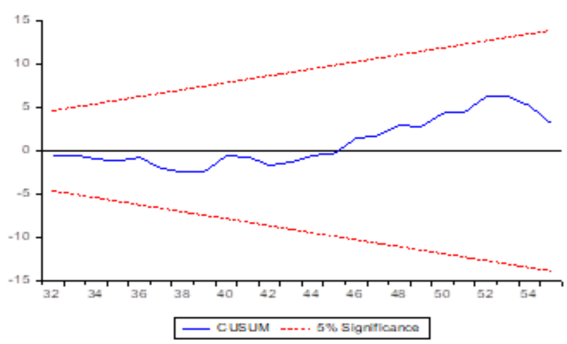
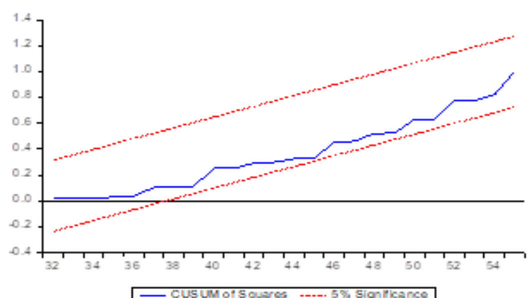
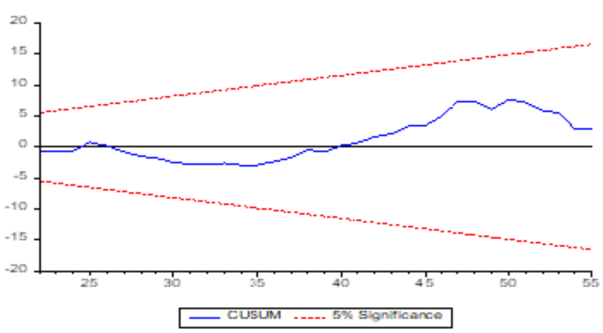
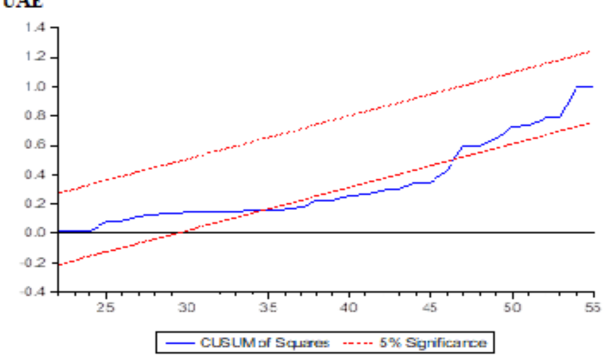




UAE





Appendix 2

Figure B: Dynamic multiplier of short-run money market rate and response to financial stability