Chapter

Targeting Financial Stability in Ghana: The Role of Monetary Policy and Macroprudential Regulations

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Abstract

This paper examines the effect of Ghana's macroprudential regulations and monetary policy on the nation's financial stability. It specifically looks at how these policies interact and what effect they have on Ghana's financial stability. This is done using the Autoregressive Distributed Lag [ARDL] model to evaluate quarterly data from 2013 Q1 to 2022 Q1 provided by the Bank of Ghana [BoG], Ghana Statistical Service [GSS], and World Development Indicators [WDIs]. The results show that macro-level prudential regulations have no long-term association with financial stability but have a favourable and significant short-term effect. Furthermore, the existence of monetary policy boosts the short-term effects of macro-level prudential regulations on financial stability but has no significant long-term influence. The study recommends that immediate concerns about financial stability can be addressed using a coordinated approach that combines macroprudential regulations and monetary policy, while fine-tuned macro-level prudential regulations should be the principal tool for long-term stability preservation. The BoG should prioritise the development and implementation of measures such as the capital adequacy ratio that address systemic risks.

Keywords: financial stability, macroprudential regulations, monetary policy, ARDL, Ghana

1. Introduction

Financial stability creates incentives for favourable economic outcomes and supports economic growth and development in any country. Ensuring financial stability is critical for an economy's smooth operation. Achieving financial stability in a country necessitates price stability, which necessitates close collaboration between money and financial factors. Financial stability inspires confidence in its users. And denotes a situation in the financial system that consists of marketplaces, financial institutions, and associated infrastructure that has the ability to support actual economic activity effectively and manage any financial disruptions brought on by unanticipated events [1].

Historically, the most important goal of monetary policy has been the attainment of economic stability, which entails researching the interdependence of financial and pricing stability. Monetary policy has been utilised to stabilise prices and financial stability [2]. However, the 2008–2009 worldwide economic downturn significantly altered the world economies and left policymakers with the tough task of restoring or sustaining macroeconomic indicators, particularly financial stability, as they were without any direction on how to do so due to the requirement to take swift action to alleviate time-pressing challenges. This is due to the fact that the crisis made them realise the inadequacies of the application of monetary policy in addressing financial vulnerabilities. In an effort to better understand the operation of their various financial systems, central bankers switched from formulating macroeconomic policy and specifically monetary policy to coordinating monetary policy and macroprudential regulations [3].

Macroprudential regulation's major goal is to sustain the financial system's stability so that it can sustainably contribute to gross domestic product growth [4]. Prior to the worldwide financial crisis, monetary policy goals frequently led to the implementation of macroprudential regulations, such as imposing reserve requirements and establishing capital requirements. But after the crisis, macroprudential regulations have become relevant with the detection of non-traditional monetary policy in many countries. And the acknowledgment that these instruments can help allay concerns brought on by the cyclical nature of finance, mostly as a result of developments in analytical modelling [2].

The synchronisation of monetary policy and macroprudential regulations is an efficient policy for achieving stability in the financial sector [3] emphasised that the interactive use of these policies is important as ensuring stability in prices does not inevitably imply stability in finances and that macroprudential regulations are required to mitigate the occurrence of the accumulation of disruptions in the financial system, which are two issues that have unquestionably garnered the most attention in the reexamination of how monetary policy is implemented. According to [5], the interactions among monetary policy and macroprudential regulations increase each policy's efficiency in accomplishing its main goal. Thus, when the two policies interact, the effectiveness of monetary policy in achieving price stability, which is its primary goal, is enhanced. Also, the efficiency of macroprudential regulations is improved by the achievement of financial stability as its primary goal. Shedding light, [4] argues that macroprudential regulations and monetary policy impact the financial system just as monetary and fiscal policies do, and the relationships between them may result in rigidities. Therefore, to reduce potential side effects from each policy, the best possible policy response is the interaction of the policies.

In recent times, Ghana has experienced shocks, with the most recent being the global COVID-19 pandemic that has affected economies worldwide. As a response to these changing economic circumstances, the Bank of Ghana [BoG] has modified its procedures over time. According to [6], while the objective of maintaining price stability has remained constant, Ghana's economic landscape and means of implementing monetary policy have altered. These modifications consist of the regulated regime that predated 1992, the implementation of monetary targeting from 1992 to 2002, and the adoption of the inflation targeting strategy since 2002, which was formally declared in 2007. In May 2007, the 2002 Bank of Ghana Act, which provided the institution with implementation-related authority, legally adopted the management of inflation rates strategy as its monetary policy framework. The policy's primary goal is price stability [low and stable inflation], which is supported by utilising

reserve requirements as a means of macroprudential regulation to manage financial stability [7]. Other macroprudential regulation instruments used by the BoG to manage development in finance institutions and reduce systemic risks in the Ghanaian financial sector are: [i] capital adequacy ratio [CAR], [ii] leverage ratio, [iii] liquidity requirement, [iv] lending limits, [v] limits on foreign currency borrowings, [vi] limits on investment, [vii] prudential returns, and [viii] Corporate governance arrangement.

The BoG, which uses the policy rate as an anchor rate for other interest rates and to stabilise the economy, has been increasing it, from 15% in 2013Q1 to 26% in 2016Q1, then slightly lower it to 15.3% in 2022Q1. The primary reserve requirement, on the other hand, a macroprudential policy tool used by the BoG to regulate financial health, has increased but started falling, particularly from 10.90 in 2013Q1 to 9.58 in 2022Q1. Despite monetary policy's contractionary trend, and relaxed macroprudential regulation, the z-scores of banks and the aggregated financial soundness indicator [AFSI] show a gradual loss in financial stability, as they decreased from 6.091 in 2013Q1 to 4.567 and -0.008 in 2013Q1 to -0.569 in 2022Q1 for the z-score and the AFSI respectively. A sign that the nation's financial sector is in poor condition.

Since the implementation of inflation targeting in 2007, it has been the main strategy used by the BoG to achieve stability of prices and financial sector in Ghana. While the reserve requirement serves as a tool for prudential supervision to manage financial stability, [7]. This shows a connection between macro-level prudential regulations and the BoG's execution of monetary policy. Existing literature in other parts of the world, such as [3–5, 8], argues that the interaction between monetary policy and macroprudential regulations improves financial stability as it eliminates conflicting policy directions. However, studies such as [2] argue that the interaction has both strengths and weaknesses, and based on our understanding, there is limited knowledge of the interplay among monetary policy and macroprudential regulations that combine to attain stability in the financial system, particularly in Ghana.

The most pertinent studies to date have concentrated on various facets of Ghana's fiscal policy, monetary policy, exchange rates, monetary policy effectiveness, financial stability measurement, and banking sector sustainability. These studies include [1, 9–13]. So far, it has been difficult to identify any study on Ghana which investigates the complementing effect of monetary policy and macroprudential policy on financial stability in Ghana.

This investigation aims to address this deficiency by exploring how financial stability is impacted by Ghana's monetary policy and macroprudential regulations. It specifically examines: the effect of macroprudential regulation on banks financial stability conditioned upon the existence of an expansionary [restrictive] monetary policy. And test the hypotheses; H_0 : The financial stability of banks in Ghana is influenced significantly by interacting actual primary reserve requirement ratio and monetary policy rate. H_1 : Coordination between the policy rate and the actual primary reserve requirement ratio does not significantly influence Ghana's banks financial stability.

2. Literature review

Monetary policy and measures to protect the financial system's interactions with one another are necessary because the operation of one policy alone has a side effect on the other. So, the interaction of the two policies produces better results by minimising the side effects present [5]. The interaction of the policies is possible,

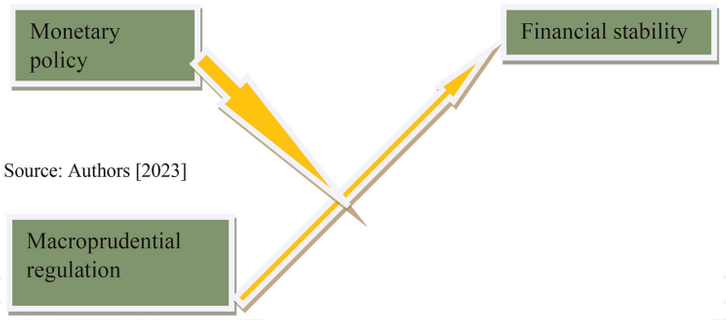

Figure 1.
Conceptual framework. Source: Authors [2023].

according to [5], in three ways. Firstly, there are a variety of "side effects" that money management policy might have on financial stability. But when it interacts with macroprudential policy, it mitigates these unintended consequences, giving monetary policy more leeway to pursue its main goal. Second, tighter macroprudential policy instruments, when operated alone, may have "side consequences" that reduce price stability. However, when combined with successful monetary policy, it can offset these impacts by increasing margin accommodation. Finally, macroprudential policy can create safety nets that can be loosened during tough financial times. Such a policy can assist in maintaining the transmission of monetary policy, retaining its efficacy in the face of such stress. Policymakers utilise these two crucial tools to ensure both price stability and financial stability: macroprudential regulation and monetary policy. All objectives are performed concurrently, and this, however, depends on the communication mechanism between the two instruments (**Figure 1**).

An increase in macroprudential regulations such as reserve requirements by the central bank will reduce the money available for lending, which will raise interest rates and lessen inflationary pressures. This will result in stable prices. Higher reserve requirements will also make the financial system more stable by guaranteeing that banks have adequate cash on hand to fulfil their obligations. Also, an increase in monetary policy, like the policy rate, by the central bank increases the costs of borrowing, which results in less lending and expenditure. This will ultimately lead to a reduction in inflationary pressures. Hence, prices will remain stable. The danger of loan defaults and other financial obligations being missed, however, is another way that increased interest rates could cause financial stability.

The integrated policy framework [IPF] by the International Monetary Fund [IMF] and the intermediate theory of money [I-theory of money] by [14] provide the study's foundation theoretical framework and the conceptual framework. The aforementioned theories and the conceptual framework serve as a reference for choosing the study variables.

2.1 The integrated policy framework [IPF]

In response to the Mundell-Fleming model's shortcomings in the years since the 2008 worldwide financial crisis the IMF created the IPF, as stated in [15]. It aims to integrate macro-level prudential regulations and monetary policy into a unified framework that addresses the objectives of financial stability and price stability. It coordinates several policy instruments to simultaneously accomplish multiple policy goals. In order to accomplish the following goals in terms of financial stability, the IPF

utilised both monetary policy and macro-level prudential regulations: Central banks normally conduct monetary policy with the aim of maintaining price stability by controlling the money supply and interest rates. Central banks can alter borrowing and lending decisions by changing interest rates, which can possess an effect on inflation and economic expansion. Also, macro-level prudential regulations strive to preserve stability in the financial sector by regulating the actions of financial institutions and markets. This may entail taking steps to regulate market players' behaviour as well as establishing capital and reserve requirements.

The IPF coordinates these two policy tools to achieve both financial stability and price stability. For instance, if inflation is high and threatens to undermine financial stability, central banks may raise interest rates to reduce inflation. However, if this causes a decline in lending and a rise in financial instability, Macroprudential regulations could be implemented to stabilise system of finance while the national bank focuses on inflation. Generally, the IPF is essential for achieving both financial and price stability and requires a coordinated approach to policy-making that takes into account the complex interactions between different parts of the economy.

2.2 The intermediate theory of money [I-theory of money]

A whole different viewpoint on optimal monetary policy—one that goes well beyond inflation targeting—is offered by the theory's conceptual foundation. The I-theory of money proposed by [14] is a model that best represents monetary policy's interaction with financial system stability. The I-theory of money contends that due to financial frictions, pricing, financial stability, and fiscal stability are interwoven. During downturns, optimal monetary policy should spot and remove balance sheet obstructions that prevent money from flowing to the economy's productive sectors. When the economy is doing well, caution is needed to avoid imbalances that leave it open to liquidity and deflationary spirals. [16] emphasise that because the level of inside money production and the cost of risk are largely determined by the health of the financial intermediation sector of an economy, there is a stable price-Related Relationship with financial stability. Thus, lowering the short-term interest rate can boost the price of long-term bonds, stabilising the balance sheets of banks. Similar to this, buying particular assets may enhance prices and so aid countries that are burdened by high debt.

2.3 Empirical review

2.3.1 Empirical examination of how monetary policy and macro-level prudential regulations work together

The interaction of monetary strategy and macroprudential regulations gained recognition after the financial crisis worldwide in 2008. There were concerns about how much financial stability goals should be considered in price-stability-oriented monetary policy frameworks, as financial instability was a nightmare during the crisis.

According to [17] study, "Investigating Monetary Policy and Macroprudential Regulations: Implications for Financial Stability and Social Welfare," when the two policies are implemented in concert, they unmistakably work together to promote both societal welfare and financial stability. Even so, when they are not coordinated, societal welfare is greatly increased.

Rubio [18] uses the New Keynesian framework to create a dynamic stochastic general equilibrium [DSGE] model solution that incorporates the real estate market as well as Savings and loan users. The macroeconomy and financial markets are stabilised by monetary guidelines and macro-level prudential policies in two different contexts: when dealing with rates for both short and long terms. According to the findings, macroprudential and monetary interventions are more ineffective at reducing interest rates with longer maturity periods. But when it comes to rates with shorter maturity periods, monetary intervention can bring about stability in finance while possibly escalating macroeconomic instability. However, macroprudential policy greatly enhances financial stability when dealing with short-term rates but only somewhat when dealing with long-term rates.

In their study entitled Analysis of macroprudential and monetary intervention in light of welfare, [19] conclude that the best combination of policies when both macro-level prudential and monetary policies are used simultaneously is the preservation of stable prices, which is the focus of monetary policy, while the macro-level prudential regulations concentrate on maintaining stability in the financial system. But adding a macroprudential regulations or broadening monetary policy both help to strengthen financial stability. Their study utilises a DSGE model with a housing market and collateral limits and investigates the interplay of macroprudential and monetary policies.

2.4 Determinants of financial stability

Many nations, including Ghana, employ capital adequacy requirements as a key tool for managing their financial sectors. According to [20], the ratio of capital to assets favours Vietnam's financial stability. His study uses the Generalised Method of Moments [GMM] model to look at how the capital adequacy ratio might affect the 18 Vietnamese commercial banks' ability to stay in business between 2010 and 2020. The study's findings suggest that CAR might help banks become more financially stable.

Glocker [21] investigated how related macroprudential regulations and financial sector stability are related and concluded that when there is a limit on the ability to alter deposit rates, the cost effect brought on by high macroprudential regulations encourages banks to select riskier assets, which worsens their financial stability. This indicates tighter macroprudential regulations affect banks' financial health negatively. Glocker and Towbin [22] examine the conditions under which macroprudential regulations can function as a policy tool for maintaining financial or price stability. This is accomplished using an example of a small open economy that involves the banking industry and persistent prices subjected to a legal macroprudential regulations as well as financial frictions. They then calculate the best interest rate and macroprudential regulations in situations where financial frictions are prominent. The study concludes that macroprudential regulations can only contribute to price stability if there are significant financial frictions and that they provide considerable benefits when financial stability is a concern.

Agur and Demertzis [23] argue that when macro-level prudential regulations are in place, monetary policy has an inverse relationship with financial stability. They investigated when macroprudential regulations mitigated monetary policy's effects on financial system stability. And simulated the risk-taking by banks as a result of monetary policy transmission as well as its interplay with a regulator's optimisation issue.

García-Herrero and Del Rio Lopez [24] studied the effects of monetary policy on financial stability and came to the conclusion that when central banks prioritise stable

prices as their main objective, financial instability is decreased. With an emphasis on monetary policy design, they add to the body of knowledge on the factors that contribute to financial stability. They also looked at how choosing central banks' goals and the related monetary tools techniques affected stable financial system in 79 countries between 1970 and 2000. Due to their dynamic economies, the study's generalizability is restricted to the chosen nations.

According to [25], countries with high lending rates have less financial stability. He investigated which banks were the riskiest. Focusing on the effect of corporate strategies on bank resilience. Koskei [26] examined the factors affecting the financial stability of Kenya's commercial banks and came to the conclusion that the banks' lending rates are detrimental to their financial stability. In his research, data from January 2015 to December 2019 were analysed using multiple linear regression. However, [27] contend that banks' high mortgage lending rates have a favourable considerable influence on the financial system's stability. They investigated the connection between sound financial conditions and mortgage lending. It performed an analysis to determine the impact of a bank's share of mortgage lending on the bank's Z-score and the percentage of non-performing loans, two financial stability indicators. The study examined 1889 banks, a sample, from 65 developed and emerging economies, between 1987 and 2014. The study by [27] focuses on developed and developing economies in Europe and Asia, which may be different in the context of Africa.

The level of inflation is a significant determinant of any economy's financial stability. Ha et al. [28] argues that a drawback relationship exists between high inflation and financial stability. But there is an advantageous association among low or stable prices and financial stability. Their investigation emphases that when there are low and stable prices, economic growth and development are improved, which reduces uncertainty, promotes efficient resource allocation, and maintains financial stability. This study, however, is a cross-economy study, and its findings may not depict a specific economic condition.

Merko and Habili [29] contend that inflation adversely impacts financial stability in the Albanian economic system. Their study intends to evaluate how Albanian commercial banks' stability is impacted by inflation, interest rates, and exchange rates. Between May 2022 and December 2015, they collected information from the Institute of Statistics of Albania [INSTAT] and the Bank of Albania. A multiple regression model was employed to examine the link between the independent variables and the dependent variable. However, this study's findings can only be broadly applied to Albania's economy.

3. Data and methodology

The study used secondary time series data produced quarterly in Ghana between 2013 Q1 and 2022 Q1. Data were gathered from the Bank of Ghana [BoG], the Ghana Statistical Service, and the World Development Indicators [WDI]. All the monthly and annual data were transformed into quarterly data. Also, by adding ROA and equity-assets ratio divided by the standard deviation of ROA, the banks' Z-score—a gauge of their financial stability—was created. Banks z-score is largely used in literature as a measure of financial stability. It measures the distance between a bank's actual financial performance and its expected financial performance based on the risks it faces and its size. It takes into account some financial ratios such as profitability,

liquidity, leverage, and asset quality and provides an overall measure of a bank's financial stability [30]. To quantify financial stability as well, an aggregated indicator [AFSI] was created using the financial soundness indicators. Loloh [31] approach was followed to develop a quarterly financial soundness indicator [AFSI] for Ghana. The AFSI was calculated using seven financial soundness indicators of the Bank of Ghana, which were first computed into sub-indices such is adequate capital, high-quality assets, efficiency, earnings, and liquidity. To avoid any single indicator having an undue influence on the aggregated index, all indicators were standardised to a common scale using the z-score formula. This process ensures that no single indicator dominates the overall index. Appendix C presents the instruments of the rest of the study variables.

3.1 Theoretical model specification

The study's theoretical model is based on the Integrated Policy Framework [IPF] by the international monetary fund [IMF]. The framework is essential for achieving both financial stability and price stability as it requires a coordinated approach to policy-making that looks for the best combination of monetary policy, and macroprudential regulations or other policies to achieve price and financial stability in an open economy [32]. To achieve the study objective, financial stability is modelled as dependent on macroprudential policy, monetary policy, the interaction of both policies, and other control variables as in the functional forms below.

$$FS = f[MR, MP, IT, V] \tag{1}$$

Where, *FS* banks' financial stability [z-score, AFSI]. MP represents monetary policy [monetary policy rate], MR represents macroprudential regulations [reserve requirement ratio], IT represents interaction term [MP*MR], and V represents other control variables.

3.2 Empirical model specification

The study's framework, and theories, lay the groundwork for the development of the empirical model. As a result, the following are the defined empirical models for the study objectives:

$$\begin{aligned} FS_t = {} & \gamma_0 + \gamma_1 MR_t + \gamma_2 MP_t + \gamma_3 MP * MR_t + \gamma_4 LR_t + \gamma_5 CAR_t + \gamma_6 BP_t + \\ & \gamma_7 NonPL_t + \gamma_8 INF_t + \gamma_9 Exc_t + u_t \end{aligned} \tag{2}$$

Where, *MP* = monetary policy, *CAR* = capital adequacy ratio, *MR* = macroprudential regulation, *LR* = lending rate, *BP* = banks profit, *INF* = inflation, *Exc* = exchange rate, and NonPL = non-performing loans.$\gamma_1, \gamma_2, \gamma_3, \gamma_4, \gamma_5, \gamma_6, \gamma_7, \gamma_8, \gamma_9$ represent the elasticities of their respective variables. γ_0, represents constant term in the equations. The subscript t, represent time and u_t is an error term in each of the equations [N [0,σ^2]].

Autoregressive distributed lag [ARDL] model is applied to the aforementioned equation. Since all the variables were fixed at either a level or a difference, the ARDL model was utilised to simultaneously determine the short-run and long-run connection. A bound test is also performed to determine whether a long-term relationship is

present. The study used the ARDL model from [33] as cited in [34], and modelled the functional link between the study variables in an ARDL model specifications form as below;

$$FS_t = \gamma_0 + \sum_{i=1}^{p} \gamma_1 FS_{t-i} + \sum_{i=0}^{n} \gamma_2 MR_{t-i} + \sum_{i=0}^{n} \gamma_3 MP_{t-i} + \sum_{i=0}^{n} \gamma_4 MP * MR_{t-i} + \sum_{i=0}^{n} \gamma_5 LR_{t-i} + \sum_{i=0}^{n} \gamma_6 CAR_{t-i} + \sum_{i=0}^{n} \gamma_7 BP_{t-i} + \sum_{i=0}^{n} \gamma_8 NonPL_{t-i} + \sum_{i=0}^{n} \gamma_9 INF_{t-i} + \sum_{i=0}^{n} \gamma_{10} exc_{t-i} + \gamma_1 FS_{t-i} + \gamma_2 MR_{t-i} + \gamma_3 MP_{t-i} + \gamma_4 MP * MR_{t-i} + \gamma_5 LR_{t-i} + \gamma_6 CAR_{t-i} + \gamma_7 BP_{t-i} + \gamma_8 NonPL_{t-i} + \gamma_9 INF_{t-i} + \gamma_{10} exc_{t-i} + u_t \quad (3)$$

Where, p = lag length of the regressand, n = lag length of the regressors, and the rest maintain their meaning as in Eq. (2).

The study hypothesis was tested by considering the significance of the main variables [MP, MR, and MP*MR] both in the short and long-terms. The parameters I [0] and I [1] were taken into account using the ARDL-bound testing method, which checks for co-integration. In the long term, the alternative hypothesis of long-run relation was evaluated against the null hypothesis of no long-run relation.

The estimated F-statistics value from the bound test is evaluated in light of [33]'s essential values to determine whether a long-run link exists. we will not be able to reject the null hypothesis that there is no long-term connection between the dependent variable and the independent variables if the estimated F-statistic is less than both the lower and upper bound critical values. In light of this, the ARDL will be executed in the first difference. The result will also be unreliable if the predicted F-statistic is between the lower and upper bounds of the crucial values. If the estimated F-statistic is higher than the upper-bound critical values, the null hypothesis, which states that there is no long-run connection, will be rejected. Eq. (4) shows the short-run dynamics that represent the error-correction factors used in the ARDL short-run model in Eq. (3).

$$\Delta FS_t = \gamma_0 + \sum_{i=1}^{n} \gamma_1 \Delta FS_{t-i} + \sum_{i=0}^{n} \gamma_2 \Delta MR_{t-i} + \sum_{i=0}^{n} \gamma_3 \Delta MP_{t-i} + \sum_{i=0}^{n} \gamma_4 \Delta MP * MR_{t-i} + \sum_{i=0}^{n} \gamma_5 \Delta CAR_{t-i} + \sum_{i=0}^{n} \gamma_6 \Delta LR_{t-i} + \sum_{i=0}^{n} \gamma_7 \Delta BP_{t-i} + \sum_{i=0}^{n} \gamma_8 \Delta NonPL_{t-i} + \sum_{i=0}^{n} \gamma_9 \Delta INF_{t-i} + \sum_{i=0}^{n} \gamma_{10} \Delta exc_{t-i} + \sum_{i=0}^{n} \gamma_{11} ECT_{t-i} + u_t \quad (4)$$

Where, ECT_{t-i} = lagged of the error correction term and Δ = difference operator.

4. Results and discussion

The descriptive statistics for the study variables are shown in **Table 1**. Rows one and two of the table display the mean and median values for the series. Also, it can be observed that the capital adequacy ratio [CAR], banks' z-scores [ZS], one of the measurements of financial stability, monetary policy [MP] as measured by the

	CAR	EXC	ZS	LR	MP	NON_PL	INF	BP	MR	AFSI
Mean	18.56	4.26	4.76	25.21	18.58	16.63	12.78	23.17	9.66	0.00
Median	18.36	4.26	4.68	25.56	17	17	11.9	21.23	9.87	0.06
Maximum	21.48	5.81	6.63	28.98	26	22.22	19.4	34.01	11.28	0.47
Minimum	15.06	1.98	3.21	20.18	13.5	11.19	7.6	11.39	7.67	−0.68
Std. Dev.	1.68	1.03	1.00	2.85	4.09	3.48	3.55	4.95	0.96	0.30
Skewness	0.01	−0.39	0.23	−0.41	0.67	−0.04	0.36	0.38	−0.35	−0.56
Kurtosis	2.02	2.51	2.06	1.78	2.08	1.73	1.88	2.84	2.28	2.37
Jarque-Bera	1.48	1.29	1.72	3.34	4.09	2.48	2.73	0.93	1.57	2.53
Probability	0.48	0.53	0.42	0.19	0.13	0.29	0.26	0.63	0.46	0.28
Sum	686.88	157.58	176.68	932.7	687.3	615.44	472.7	857.3	357.58	0.01
Sum Sq. Dev.	102.11	37.84	36.28	291.6	600.8	435.69	454.09	882.8	33.08	3.16
Observations	37	37	37	37	37	37	37	37	37	37

Note: Std. Dev. = standard deviation and Sum Sq. Dev = sum of square deviation.
Source: Authors [2023].

Table 1.
Descriptive statistics.

monetary policy rate, banks' profit [BP], which is measured by return on equity, and inflation [INF] as measured by the consumer price index, are skewed positively. This indicates that the vast majority of their values are below the corresponding variables' means. Whereas, the exchange rate [EXC], lending rate [LR], non-performing loans [non-PL], macroprudential regulation [MR] as measured by actual primary reserve requirement, and aggregate financial soundness indicator [AFSI], a measure of financial stability, are negatively skewed. As a result, it may be inferred that the majority of their values are higher than the corresponding variables' means.

Data points appear to be more densely clustered together [no outliers], according to the variables' standard deviation. This is due to the fact that all of the variables' standard deviations are relatively low when compared to their respective means, or that the difference between the minimum and maximum values is not very wide. All of the variables are expected to have a normal distribution at the 5% level of significance, according to the probability values of the Jarque-Bera test. This is the case since all of the study's probability values are higher than 5% [0.05]. This implies that the variables' distribution in their natural state is sound and that they should not be logged. Additionally, when subjected to the Jarque-Bera test for all the variables, the study fails to refute the null hypothesis of a normal distribution.

The kurtosis statistic describes the shape of a series' distribution, specifically indicating how peaked or fat the distribution is. A kurtosis of 3 is considered mesokurtic, representing the shape of a standard normal distribution. From the table above, it is clear that the kurtosis coefficients of all the variables are less than 3. This suggests that the dataset is leptokurtic, which has lighter tails than a normal distribution.

4.1 Unit root test

The mean, variance, and other features of time series data frequently fluctuate throughout time since they are rarely steady. This makes it critical to test for

stationarity before conducting any analysis, as non-stationary data can lead to inaccurate results. The stationary test is useful in this study because it is used to determine whether or not the data used for the study is stationary. If the data is not stationary, the ARDL model employed cannot produce consistent long-run estimates. Due to the fact that the ARDL consistently yields findings when the variables are stationary at either level [integrated of order zero, or I [0]] or first differences [integrated of order 1, or I [1]]. In order for the ARDL technique to cointegration to work, the series included in the model must have integration of order d, where d can range from 0 to 1 [$0 \leq d \leq 1$].

Different methods are used to test for variable stationarity. With the help of Augmented Dickey-Fuller [ADF] tests and Phillips-Perron [PP] unit root tests, the exact order of integration for all of the variables in levels and first difference was found. To ensure the sequence of integration of the variables, the unit root tests were run with intercepts, trends, and intercepts as well as without trends and intercepts. The ideal number of lags or lag lengths included in the test were also chosen automatically using Schwartz, Bayesian Information Criteria, and Akaike Information Criteria [AIC]. The results of the ADF and PP unit root tests are shown separately in **Tables 2** and **3**.

The null hypothesis, which states that a unit root exists in the majority of the variables at their original levels, cannot be disproved based on the ADF results in **Table 2**. This is due to the probability values [p-values] for the ADF are not significant according to the standard statistical thresholds, statistics [1%, 5%, and 10%], except for inflation [INF], and monetary policy [MP], which are stationary at 5%, and 10%, significance thresholds with intercept. On the other hand, at first differences, all the variables were stationary as their test statistic values were less than 1%, 5%, and 10% significance levels, and their p-values were statistically significant.

	Levels			First difference		
Variable	**Intercept**	**Trend**	**No trend**	**Intercept**	**Trend**	**No trend**
INF	−3.118**	−0.477	0.581	−2.718*	−2.642	−2.711***
ZS	−1.619	−1.460	−0.912	−6.011***	−4.852***	−6.072***
CAR	−1.570	−2.639	0.182	−5.959***	−5.934***	−6.013***
MP	−2.839*	−3.035	−0.317	−2.235	−2.071	−2.270**
LR	0.207	−1.866	−1.321	−5.365***	−5.423***	−5.086***
MR	−2.119	−3.065	−0.706	−4.775***	−4.699***	−4.825***
BP	−1.252	−1.039	−0.851	−6.360***	−6.333***	−6.393***
EXC	−2.500	−0.592	0.737	−5.134***	−5.929***	−5.033***
Non-PL	−1.887	−2.658	0.176	−4.859***	−4.837***	−6.397***
AFSI	−0.993	−1.838	−1.175	−6.375***	−6.714***	−6.446***

Trend = trend and intercept, No trend = No trend and No intercept.
Source: Authors [2023].
**10% signification level. **5% signification level. ***1% signification level.*

Table 2.
Results of Augmented Dickey-Fuller [ADF] Unit Root Test.

	Levels			First difference		
Variable	**Intercept**	**Trend**	**No trend**	**Intercept**	**Trend**	**No trend**
INF	−1.295	−1.131	0.334	−2.509	−2.381	−2.497**
ZS	−1.619	−1.491	−0.949	−6.010***	−5.980***	−6.071***
CAR	−1.398	−2.541	0.462	−6.745***	−7.255***	−6.465***
MP	−1.272	−1.925	−0.241	−2.933	−2.071	−2.270**
LR	0.302	−2.254	−1.359	−5.357***	−5.427***	−5.083***
MR	−2.149	−2.280	−0.876	−5.390***	−5.350***	−4.916***
BP	−1.474	−1.953	−0.548	−5.706***	−6.556***	−5.669***
EXC	−2.449	−0.585	0.566	−5.142***	−5.940***	−5.038***
Non-PL	−1.791	−2.701	0.176	−6.354***	−6.221***	−6.396***
AFSI	−1.112	−1.525	−1.227	−6.479***	−15.840***	−6.533***

*Note: ***, **, and * represent 1%, 5% and 10% signification level respectively, Trend = trend and intercept, No trend = No trend and No intercept.*
Source: Authors [2023].

Table 3.
Results of Phillips Perron [PP] unit root test.

F-Bounds Test [z-score]		Null hypothesis: no levels relationship		
Test statistic	**Value**	**Significance**	**I [0]**	**I [1]**
F-statistic	7.122	10%	2.03	3.13
K	7	5%	2.32	3.50
		1%	2.96	4.26

Table 4.
ARDL Bound Test Results Model A.

The outcomes of the Phillip Perron unit root test are displayed in **Table 3**, along with the intercepts, trend, and absence of both. As can be seen, none of the variables in the table are free of unit root at levels. Hence, the study fails to disprove the unit root null hypothesis at all levels, as the various variables respective p-values are insignificant and their absolute critical values are greater than all the significance levels. But all the variables eventually become stationary. This is as a result of the fact that all p-values for the variables are statistically significant at the different levels of significance [1%, 5%, and 10%]. Additionally, at the traditional significance thresholds, their respective t-statistics are higher than the absolute critical values. As shown in **Tables 3** and **4**, respectively, the majority of the variables display first-order integration, designated as I [1], when the model takes into account the intercept, trend, and lack of trend. Some of the variables are integrated at the order zero level, according to the unit root test's findings on certain of the variables, hence I [0], indicating that they are stationary at levels. In particular, in the ADF with intercept. Furthermore, the results of the test prove that the majority of the variables are I [1], indicating stationary at first differences. These findings support the applicability of the ARDL estimation method used in the methodology.

4.2 Co-integration test

In accordance with the goal of the investigation, the bound test for co-integration is used to determine if a long-term link exists in the models of the study. According to [33], an ideal lag length is needed for the bound test in the ARDL model, which was the approach adopted in this work. Due to the relatively limited sample size and to prevent degrees of freedom from being lost, the study consequently utilises an ideal latency of 2. Hence, a maximum lag length selection structure for the objectives were chosen at 2.

4.3 Lag selection structure

After selecting the optimal lag at 2, the study allows the software [EViews 10.0] to automatically generate a specific optimal lag length for each of the variables based on the Akaike Information Criterion [AIC]. The Akaike Information Criterion [AIC] is useful because it compares the information entropy of different models using a measure known as Kullback-Leibler divergence. The AIC also assesses the amount of information sacrificed by a model, indicating that models with lower information loss are considered higher quality than others.

To achieve the study's objective, two models are estimated. Model A, which contains both monetary policy and macroprudential regulation as well as control variables, and Model B, which contains both monetary policy and macroprudential regulation plus the interaction of the two policies and other control variables.

4.4 Bound test results [Model A]

F-Bounds Test [AFSI]		Null hypothesis: no levels relationship		
Test statistic	**Value**	**Significance**	**I [0]**	**I [1]**
F-statistic	3.114	10%	2.03	3.13
K	7	5%	2.32	3.50
		1%	2.96	4.26

Note: k = number of regressors in the model, Z-score = banks' Z-score, AFSI = aggregated financial soundness indicator, I [0] = integrated at levels, and I [1] = co-integrated at first differences.
Source: Authors [2023].

The study's regressors and the Z-score, which measures financial stability, are co-integrated, according to **Table 4**. As a result, the F-statistic for the Z-score, which is 7.122, is higher than the upper bound [I [1]] critical values at 5% [3.50]. Additionally, the F-statistic of 7.122 for the Z-score exceeds the lower bound [I [0]] critical values at 5% [2.32]. However, there is no co-integration between the AFSI measure of financial stability and the regressors. This is because its F-statistic of 3.144 is less than the 5% [I [1]] crucial upper bound values [3.50]. Because of this, the null hypothesis that there is no long-run relationship between financial stability and macroprudential regulation in Ghana is rejected because the Z-score assessed for financial stability is co-integrated at I [0] and I [1]. As a result, the analysis supports the alternative hypothesis that in Ghana, there is a long-term connection between financial stability and macroprudential regulation. In order to estimate the long-run coefficients and short-

run dynamic effects for solely the Z-score measure, the study uses the ARDL cointegration approach. However, it estimates the AFSI measure in the first difference for the short-run effect. The study model A with diagnostic test, the long-run and short-run outcomes are shown in **Tables 5** and **6**.

Dependent variable: D [Z-SCORE]				
Regressors	**Coefficient**	**Standard error**	**T-Statistic**	**Probability**
MR	−0.197	0.365	−0.541	0.597
MP	−0.436	0.127	−3.442	0.004
LR	0.220	0.190	1.158	0.266
CAR	0.123	0.242	0.507	0.620
NON_PL	−0.054	0.090	−0.603	0.556
INF	0.381	0.111	3.429	0.004
EXC	−0.206	0.233	−0.887	0.390

Table 5.
Long-run coefficients, ARDL [2, 2, 2, 1, 2, 1, 2, 1].

Dependent variable	**D [Z-score]**		**D [AFSI]**	
Regressors	**Coefficient**	**Std. Error**	**Coefficient**	**Std. Error**
C	2.211***	0.249	−0.002	0.028
D [FS [-1]]	0.265**	0.107	−0.362*	0.189
D [FS [-2]]			0.299	0.210
D [MR]	0.133	0.088	0.080	0.067
D [MR [-1]]	0.336***	0.084		
D [MP]	−0.351***	0.072	0.141**	0.062
D [MP [-1]]	0.329***	0.067	−0.042	0.060
D [MP [-2]]			0.083	0.048
D [LR]	−0.092	0.069	0.011	0.067
D [LR [-1]]			0.014	0.053
D [LR [-2]]			−0.159**	0.072
D [CAR]	0.071**	0.052	0.095**	0.044
D [CAR [-1]]	−0.108***	0.048	−0.050	0.040
D [CAR [-2]]			−0.106**	0.049
D [NON_PL]	0.077***	0.022	0.060***	0.016
D [NON_PL [-1]]			0.036*	0.017
D [INF]	−0.095***	0.028	−0.043*	0.021
D [INF [-1]]	−0.147***	0.040	−0.055*	0.028
D [INF [-2]]			−0.055*	0.028
D [EXC]	0.717***	0.154		

Dependent variable	**D [Z-score]**		**D [AFSI]**	
Regressors	**Coefficient**	**Std. Error**	**Coefficient**	**Std. Error**
D [BP]			0.047***	0.015
D [BP [-1]]			0.058***	0.015
D [BP [-2]]			0.046***	0.015
ECT [-1] *	−0.573***	0.062		
		Diagnostic tests		
	R-squared = 0.856		R-squared = 0.798	
	Adjusted R-squared = 0.767		Adjusted R-squared = 0.488	
	F-statistic = 9.601		F-statistic = 2.572	
	Prob[F-statistic] = 0.000		Prob[F-statistic] = 0.042	
Test	**F-statistics**		**F-statistics**	
Heteroscedasticity	0.999 [0.512]		0.923 [0.576]	
Serial correlation	1.032 [0.386]		0.251 [0.782]	
Normality [Jarque-Bera]	0.339 [0.844]		0.665 [0.717]	
Misspecification	0.033 [0.859]		2.578 [0.112]	

Note: Probability values are in parentheses.
Source: Authors [2023].

Table 6.
Short-run coefficients.

4.5 Model a results [without interaction term]

In this model, the optimal lag was set at 2, while the software automatically generated appropriate lags for each of the variables. The lags for the regressors are [2, 2, 2, 1, 2, 1, 2, 1].

4.6 Interpretation and discussion of the long-run relationships

Table 5 shows the long-term relationship between financial stability and the regressors. The findings show that macro-level prudential regulations have a statistically negligible negative effect on financial stability when monetary policy and those regulations are included in the same model. The Long-term analysis rules out the null hypothesis that macroprudential regulation has a significant effect on financial stability when monetary policy is held constant. Therefore, there is no statistically significant impact of macroprudential regulation on financial stability.

Monetary policy has an unfavourable statistically significant effect on financial stability as measured by the Z-score of banks, indicating an inverse effect on financial stability. Thus, a cedi increase in the policy rate will reduce financial stability by 0.436. This is related to the claim made by [23] that monetary policy has a detrimental

effect on financial stability when there are macro-level prudential regulations in place. The inverse effect can be due to high borrowing costs from high interest rates as a result of contractionary monetary policy, which makes borrowing more expensive for businesses and individuals. This leads to reduced investment and consumption, which negatively affect economic growth and financial stability. Thus, if businesses and households face difficulties servicing their existing debts due to high interest payments, it can increase the risk of defaults and financial distress.

To account for the control variables, only inflation is statistically significant over the long run and shows a favourable impact on financial stability. It suggests that a 1% increase in inflation will result in a 0.381 increase in financial stability. Although it seems contradictory, [28] research supports their claim that financial stability is enhanced by low or constant inflation. Because when there are low and stable prices, economic growth and development are improved, which reduces uncertainty, promotes efficient resource allocation, and maintains financial stability.

4.7 Interpretation and discussion of the short-run relationships

The short-run effects of macroprudential regulation, subject to the existence of monetary policy, are depicted in **Table 6**. Based on the results, macroprudential regulations in place now have a favourable but statistically negligible effect on financial stability. However, when financial stability is assessed using the Z-score, past macroprudential regulations has a statistically significant favourable impact on it. The effects of monetary policy at levels where financial stability is measured by z-score of banks confirmed that monetary policy has a detrimental long-term impact on financial stability. Again, in the short term, when measures by the AFSI and lag one of the Z-score measure are taken, the monetary policy has a strong beneficial impact on financial stability. This is consistent with [18, 24] findings.

Accounting for the control variables in the short run, the CAR, exchange rate, defaulted loans, and bank profit have a positive influence on financial stability with statistical significance. However, inflation has a statistically significant negative effect on financial stability, which aligns with the findings of [29]. And the lending rate has been insignificant in the short run.

The error correction term [ECT], which gauges how quickly an equilibrium transitions from a short-term disequilibrium to a long-term equilibrium, is statistically significant at the 1% level and also indicates a negative trend for the z-score equation. It indicates that following a short-term shock, the short-term outcomes will adjust towards a long-term equilibrium. In particular, disequilibrium in the short run is expected to return to equilibrium in the long run by 57.3% in the Z-score model.

Table 6 also shows the diagnostic tests of the two models [Z-score and AFSI]. The tests are carried out to check the robustness of the models. Hence, stability, normality, heteroscedasticity, misspecification, and autocorrelation in the ARDL models are tested. All the null hypotheses for the robustness check tests are not rejected. It therefore concludes that the study models are free from heteroscedasticity, misspecification problems, autocorrelation, and the residuals are normally distributed.

The models are stable, as evidenced by the CUSUMSQ and CUSUM charts which is consistent with [33] stability test in an ARDL specification. As shown in Appendix A, both specifications' 5% critical value boundaries are not exceeded by the residuals of

CUSUM and CUSUMSQ. This indicates that the models are in good shape. As a result, the ARDL equations remain stable over the entire period investigated.

4.8 Model B [interaction]

The interaction term is added to test the potency of the policies on financial stability. Macroprudential regulation and monetary policy play complementary roles in Ghana under the framework of inflation targeting to achieve stability in the economy which include financial stability. According to [5], each policy's efficiency is improved when they interact. But based on the outcomes of model A, where monetary policy and macroprudential regulations are included in one equation, The z-score of banks, which is a gauge of both short- and long-term financial stability, is negatively impacted by monetary policy in a statistically meaningful way. While macroprudential regulation has an immediate positive insignificant effect on the z-score and the AFSI measures of stable finance and a long-term negative insignificant influence on the z-score.

4.9 Bound test results [Model B]

The outcomes of the bound test in **Table 7** demonstrate that the regressors and financial stability have a long-term connection. This is so because the F-statistics of 7.218 and 3.561 surpass the 5% [I [1]] critical value [3.39]. Additionally, the F-statistics 7.218 and 3.561 for the Z-score and the AFSI, respectively, are greater than their [I [0]] critical value at 5% [2.22]. Therefore, the null hypothesis that there is no long-run relationship between financial stability and the regressors is rejected since the research variables are co-integrated at I [0] and I [1]. As a result, the study found a long-term association between financial stability and the factors examined. This implies that adjustments to these variables over time refer to modifications in financial stability. The study's estimation of the level coefficients and short-term dynamic effects using the ARDL cointegration approach. **Tables 8** and **9** display the short and long-term findings, respectively.

F-Bounds Test [z-score]		**Null hypothesis: no levels relationship**		
Test statistic	**Value**	**Significance**	**I [0]**	**I [1]**
F-statistic	7.218	10%	1.95	3.06
K	8	5%	2.22	3.39
		1%	2.79	4.10
F-Bounds Test [AFSI]		**Null hypothesis: no levels relationship**		
Test Statistic	**Value**	**Significance**	**I [0]**	**I [1]**
F-statistic	3.561	10%	1.95	3.06
K	8	5%	2.22	3.39
		1%	2.79	4.10

Source: Authors [2023].

Table 7.
ARDL bound test results Model B.

Dependent variables	D [Z-SCORE]		D [AFSI]	
Regressors	**Coefficient**	**Standard error**	**Coefficient**	**Standard error**
MR	−1.564	2.055	5.026	2.894
MP	−1.824	1.112	3.874*	2.113
MPMR	0.117	0.124	−0.316	0.182
CAR	0.997**	0.432	−0.560	0.413
LR	1.253**	0.442	−0.965	0.603
NON_PL	0.299	0.168	0.183	0.141
INF	0.320	0.179	−0.389*	0.212
EXC	−0.084	0.228		
BP			0.496	0.250

*10% signification level.**5% signification level.***1% signification level.

Table 8.
Estimated long-run interactive effect coefficients.

Dependent variable	D [Z-SCORE]		D [AFSI]	
Variable	**Coefficient**	**Standard error**	**Coefficient**	**Standard error**
C	−20.749***	1.865	−11.690***	1.540
D [FS [-1]]	0.626***	0.103	−0.621***	0.134
D [MR]	2.914***	0.536	0.001	0.200
D [MR [-1]]	2.977***	0.531	−1.152***	0.210
D [MP]	1.145***	0.314	0.106	0.118
D [MP [-1]]	1.766***	0.310	−0.749***	0.132
D [MPMR]	−0.131***	0.030	0.001	0.011
D [MPMR [-1]]	−0.157***	0.031	0.071***	0.013
ECT [-1] *	−0.788***	0.071	−0.307***	0.040
		Diagnostic tests		
R-squared	R-squared = 0.929		R-squared = 0.898	
	Adjusted R-squared = 0.857		Adjusted R-squared = 0.807	
	Prob[F-statistic] = 0.000		Prob[F-statistic] = 0.000	
Test	**F-statistics**		**F-statistics**	
Heteroscedasticity	1.172 [0.424]		1.090 [0.466]	
Serial correlation	1.755 [0.241]		2.362 [0.157]	
Normality [Jarque-Bera]	0.853 [0.653]		0.999 [0.607]	
Misspecification	0.833 [0.388]		0.393 [0.546]	

Table 9.
Estimated short-run interactive effect coefficients.

4.10 Interpretation and discussion of the interactive effect results

The results of the interaction among monetary policy and macroprudential regulation regarding stability of the financial sector are shown in **Tables 8** and **9** for both the long-run and the short-run. Exchange rate, lending rate, non-performing loans, inflation, and the capital adequacy ratio were controlled for in the z-score equation. For the AFSI equation, the capital adequacy ratio, lending rate, non-performing loans, inflation, and banks' profits were controlled for. The interactive effect of the policies was found by taking the derivative of the equations in Appendix B with respect to each policy, and the outcomes are shown in **Table 10**.

Based on **Table 8**'s long-term findings the interaction term for both the z-score equation and the AFSI equation is statistically insignificant. Also, it is insignificant in the AFSI equation in the short-run as in **Table 9**. This means that there is no statistically significant effect of the interaction of the two policies in the long-run as well as in the AFSI equation in the short-run. However, the interaction term is statistically significant for the z-score equations in the short-run. Hence the interpretation is based on the z-score equation in the short-run.

It was found that, conditioned upon the presence of monetary policy, financial stability is statistically significantly improved by macroprudential regulation. According to the findings, at 1.145 of monetary policy, macroprudential regulation enhances financial stability by 2.764 in the short run. Rubio and Carrasco-Gallego [17] support these findings in their study, which concludes that when the two policies are operated in a coordinated manner, they unmistakably cooperate to advance financial stability. According to [19], macro-level prudential regulations have the capability to increase financial stability when monetary policy and other regulations are used concurrently, which is in accordance with the results of the current investigation. The findings were further supported by [18] study, which makes the case that macroprudential regulation considerably enhances financial stability when dealing with short-term rates. The null hypothesis of a significant effect of macro-level prudential regulation on the stability of finance conditioned upon the existence of monetary policy is not rejected. There is therefore a noteworthy effect of macroprudential regulation on financial stability conditioned upon the existence of monetary policy.

The motive for the improvement in the degree to which macroprudential regulation influences financial stability positively upon the existence of monetary policy can be bubbles in asset prices and rapid credit expansion. When asset prices are inflated and loan growth is rapid, high policy rates, which measure monetary policy, result in high interest rates, making debt more expensive for borrowers. It also dampens asset price bubbles, thus complementing macroprudential regulations aimed at maintaining financial stability. Also, the two policies operate under the inflation targeting framework; hence, their objectives could overlap.

	Short-Run	
Dependent variable	**D [Z-SCORE]**	**D [AFSI]**
$\frac{\partial FS}{\partial MP}$	0.763***	0.106
$\frac{\partial FS}{\partial MR}$	2.764***	0.001

Source: Authors [2023]

Table 10.
Marginal effect results.

Additionally, when employed together, money management strategies and macroprudential supervision might lessen the possibility of financial instability. Monetary policy, for instance, can be used to slow the economy down if it is growing too quickly and causing asset bubbles. When the economy is growing too quickly and causing asset bubbles, contractionary monetary policy may be implemented to increase interest amounts in the economy, which makes it expensive for businesses and consumers to borrow. Thus, slowing the quick growth and asset price bubbles. To limit the amount of risk that financial institutions take on, macroprudential regulation can be used. Thus, tightening macroprudential regulations such as the reserve requirement helps ensure that banks' will be able to meet their obligations to depositors and creditors.

The findings also suggest that monetary strategy has a short-term statistically significant positive effect on financial stability [z-score]. Thus, at 2.914 of macroprudential regulation, monetary policy improves financial stability by 0.763. This therefore confirms its complementary function in enhancing the effect of macroprudential regulation on financial stability and the findings of [18], as he argues that short-term rates can achieve financial stability while potentially increasing macroeconomic volatility. García-Herrero and Del Rio Lopez [24] also support the findings when they conclude that monetary policy helps reduce the risk of financial instability. This is possible because lower interest rates in the country, resulting from a low monetary policy rate by the BoG, make it cheaper for businesses and consumers to borrow money. This can help stimulate economic activity and prevent financial instability.

The ECT, which gauges the rate of transition from a short-term disequilibrium to a long-term equilibrium, is negative, statistically significant, and holds for both the z-score equation and the AFSI. These significant and negative adjustment coefficients support the long-term conclusions. They imply that after a short-term shock, the results will adjust towards a long-term equilibrium. In the Z-score and AFSI models, short-term imbalance is expected to return to balance over the long term by 78.8% and 30.7%, respectively.

Diagnostic tests of the two models [Z-score and AFSI] are also shown in **Table 10**. The tests for stability and diagnosis are performed to ensure the models' robustness. As a result, the ARDL models' stability, normality, heteroscedasticity, misspecification, and autocorrelation are examined. For the robustness check tests, the study fails to reject all null hypotheses. As a result, it is concluded that the study models are free of heteroscedasticity, misspecification, and autocorrelation and that the residuals are normally distributed. This is because their p-values [0.424, 0.388, 0.241, and 0.653] and [0.466, 0.546, 0.157, and 0.607] of the tests are greater than the 5% significance level. According to the CUSUM and CUSUMSQ graphs in Appendix A, the models are also stable.

5. Conclusion and recommendation

The investigation's purpose is to determine how monetary policy and macroprudential regulation affect Ghana's financial stability. This study's significance is due to the interaction between the policies' effects on Ghana's financial stability. The findings indicate that in targeting financial stability in the country, only in the short term should monetary policy and macroprudential regulations interact. Because, in the presence of monetary policy, macroprudential regulation has a significant positive

effect in relation to short-term financial stability but is insignificant over time. Also, with the existence of macroprudential regulation, financial stability is significantly improved in the short run by monetary policy. Capital-based macroprudential regulations, such as capital adequacy ratios, should be used to stabilise the financial sector over the long term because they have a positive long-term impact on financial stability. The study therefore, recommends that a coordinated strategy combining monetary policy and macro-level prudential regulations can be adopted when there are imminent concerns about financial stability. This entails using monetary policy tools like the policy rate and liquidity management in conjunction with targeted macroprudential regulations like the primary reserve requirement to address specific vulnerabilities or imbalances in the financial system. Lastly, over time, the primary tool for maintaining financial stability should be improved and fine-tuned macroprudential regulations. The BoG should prioritise the development and implementation of measures that address systemic risks such as the capital adequacy ratio.

A. CUSUM and CUSUMSQ for Z-SCORE and AFSI

Model A: without interaction term (**Figure A1**).
Model B: with interaction term (**Figure A2**).

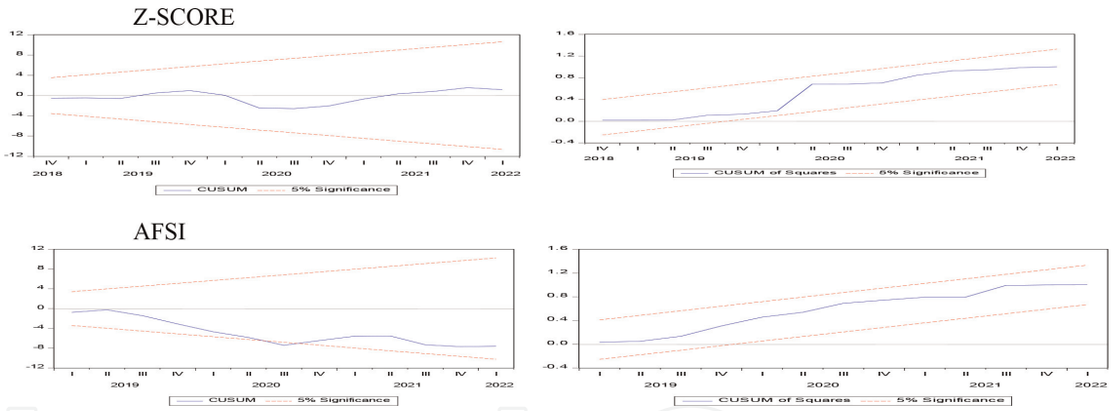

Figure A1.
CUSUM and CUSUM SQUARED Test for stability for Model A.

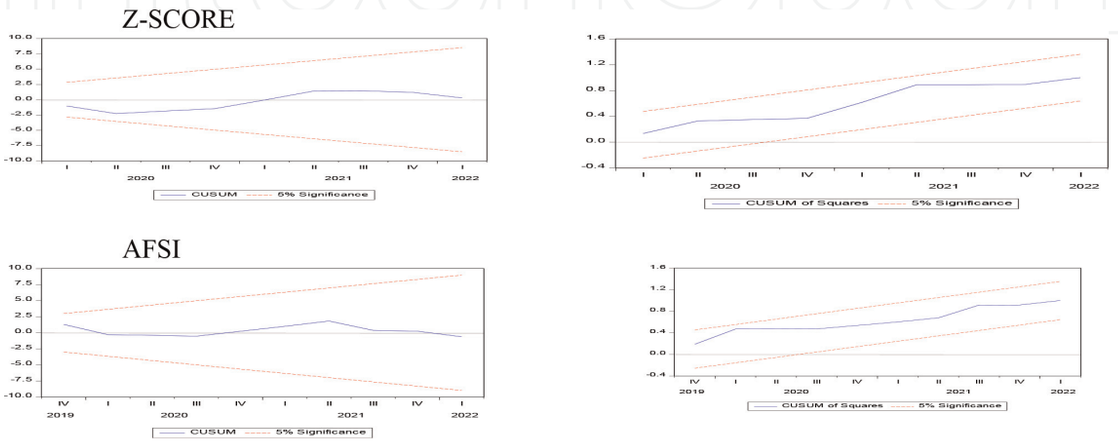

Figure A2.
CUSUM and CUSUM SQUARED Test for stability for Model B.

B. Marginal effect equations

$$FS_t = \gamma_0 + \gamma_1 MR_t + \gamma_2 MP_t + \gamma_3 MP * MR_t \ldots\ldots\ldots * * * \quad (5)$$

$$\frac{dFS_t}{dMR} = \gamma_1 + \gamma_3 MP \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots * * \quad (6)$$

$$\frac{dFS_t}{dMP} = \gamma_2 + \gamma_3 MR \ldots\ldots\ldots\ldots\ldots\ldots\ldots * \quad (7)$$

C. Variables and measurement

Variable	Measurement	Source
Lending rate	Average Commercial Banks Lending Rate	BoG
Banks' profit	Return on equity [ROE]	BoG
Exchange rate	Official exchange rate [LCU per US$, period average]	WDI
Banks' financial stability	Z-score = $\frac{ROA+E/A}{\sigma ROA}$ and $AFSI_t = \frac{\sum_{j=1}^{5} z_{ij}}{5}$	BoG
Inflation	Year-on-year consumer price index	GSS
Monetary Policy	Monetary policy rate	BoG
Macroprudential regulation	Actual primary reserve requirement ratio	BoG
Capital adequacy ratio	Basel III framework,	BoG
Non-performing loans	Total amount of non-performing loans/total amount of loans in the lender's portfolio.	BoG

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