



**Macroeconomic determinants of interest rate spreads in
Ghana**

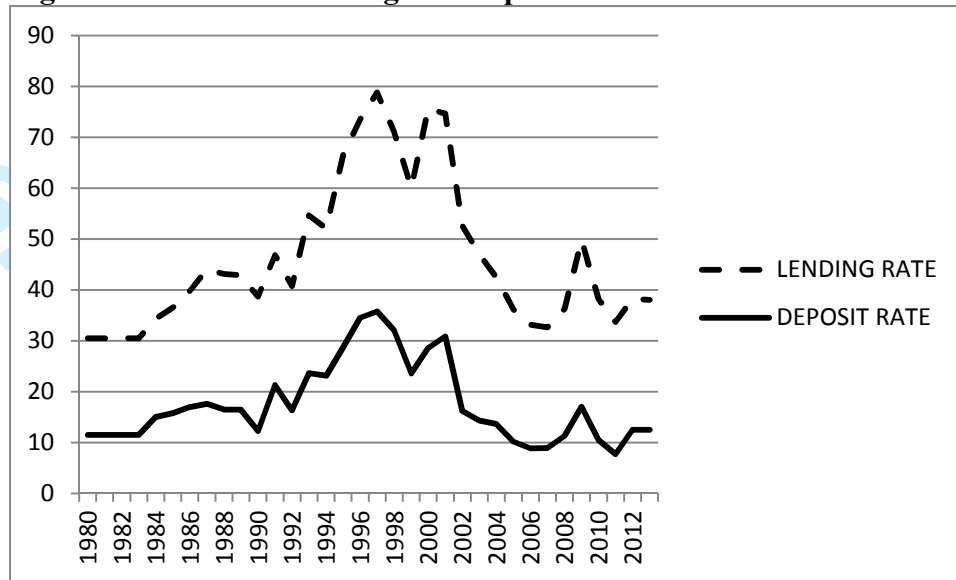
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1.0 Introduction

In the last few decades Ghana has pursued reforms in its financial sector, aimed at making the sector more efficient and sustainable. The reforms programme which was implemented under the Financial Sector Adjustment Programme (FINSAP) and the Financial Sector Strategic Plan (FINSSP) involved the liberalisation of the financial sector, restructuring of financial institutions, and enhancement of banking regulations. This was done largely to support the economic growth agenda of the country. These reforms have resulted in various regulations and laws that have allowed more entry into the financial market, as well as greater openness aimed at reducing commercial bank collapse and folding up (Korsah et al., 2001; Aryeetey and Senbet, 2004; Biekpe, 2011). What is crucial among the reform policies is the adoption of a freely floating and highly independent interest rate system. Within this context, commercial banks are freely able to determine their interest rates after taking into consideration factors specific to the banking industry (including bank-specific costs and profit factors), and the monetary policy rate as determined by the central bank (see Korsah, et al., 2001; Aryeetey and Senbet, 2004; Biekpe, 2011). This has led to disparities on what is received on deposits compared with what is paid on loans, with the former mostly a lot lower than the latter. The huge spread (lending rate minus deposit rate) has been attributed to unfavorable macroeconomic factors and factors specific to the banking industry (Bawumia, et al., 2005; Aboagye et al., 2008; Owusu-Antwi, 2013; Quartey and Afful-Mensah, 2014). Interest rate spreads indicate the cost of bank intermediation. Therefore, high spreads may signal inefficiency in the banking industry which may negatively affect savings and investment in the domestic economy (see Brock and Rojas Suarez, 2000). Increasing interest rate spreads are more likely to be detrimental to developing countries given the fact that their financial markets are not well developed and their huge dependence on banks for financial needs (Peria and Mody, 2004).

A plot of deposit and lending rates in Ghana for the period 1980-2013 indicates lending rate was much higher for all periods than deposit rate. Notwithstanding, the early 1980s saw reduced spreads possibly due to the fact that the financial sector was not much liberalised as rates were largely controlled by the government. Since financial liberation in the mid-1980s, spreads have continually widened with the greatest differences occurring between 1994 and 2000. This is not surprising as the period 1994-2000 was characterized by huge macroeconomic instability as the economic gains from the Structural Adjustment Programme were largely eroded (ISSER, 2013). Periods since then have seen fluctuating trends between the two rates, with lending rate much higher than deposit rate. With the current macroeconomic fundamentals of the economy gradually nearing those of the 1994-2000 periods (see ISSER, 2013; Bawumia, 2014; IMF, 2014), questions are often asked as to whether similar implications on spreads should be expected. It is worth noting that comparatively, Ghana's financial sector is relatively becoming more developed, liberalised and less concentrated. This implies competition is now greater which may be reducing collusion among banks in the determination of interest rates. These do not however preclude any negative effects of macroeconomic variables on spreads in Ghana.

Figure 1: Trends in Lending and Deposit Rate in Ghana for 1980-2013

Source: Authors

Why are deposit interest rates significantly different from lending rates in Ghana? What causes the gap between the two rates, with the latter largely higher than the former? These two questions bother lenders and borrowers more often than has been considered. The situation is further worsened by the fact that monetary policy rate keeps rising, deficits are increasing, crowding-out effect keeps deepening, the Ghana Cedi is depreciating, inflation rates keep rising, and economic growth is declining in recent years (ISSER, 2013; Bawumia, 2014). Do these happenings have any implications for interest rate spreads in Ghana? The study therefore examines macroeconomic determinants of interest rate spreads in Ghana for the period 1980-2013.

It is worth stating that there may be a trade-off regarding the relevance or otherwise of spreads. As earlier indicated, a banking atmosphere with high spreads may suggest low banking competition, excessive risk taking or inefficiency. Notwithstanding, an atmosphere characterized by high spreads may lead to high bank profits, which can enhance the safety and reliability of the banking system if such funds form part of the system's capital base. Barajas et al. (1999) particularly notes this situation for developing countries. As to whether low spreads should be preferred to higher ones or vice versa is however unclear (see Barajas et al., 1999).

While some authors attribute the determinants of spreads to the structure of the capital market (see Bain, 1951; Hannan and Berger, 1991; Neumark and Sharpe, 1992; Barajas et al, 2000; Jayaraman and Sharma, 2003; Hofman and Mizen, 2004; Chirwa and Mlachila, 2004; Samuel and Valderrama, 2006; Kwakye, 2010; Sarpong et al., 2011), others "blame" bank-specific factors (see Ho and Saunders, 1981; Demirguc-Kunt and Huizinga, 1998; Ngugi, 2001; Moore and Craigwell, 2002; Brock and Rojas-Suarez, 2000; Robinson, 2000; Gelos, 2006; Sologoub, 2006; and Crowley, 2007; Garr and Kyereboah-Coleman, 2013). These arguments notwithstanding, spreads have also been found to be influenced by macroeconomic factors (see Randall, 1998; Brock and Franken, 2002, 2003; Tennant, 2006; Crowley, 2007; Folawewo, and Tennant, 2008; Sheriff and Amoako, 2014). Although similar studies on Ghana has been

conducted (see Bawumia, et al., 2005; Aboagye et al., 2008; Kwakye, 2010; Garr and Coleman, 2013; Sarpong et al., 2013; Churchill et al., 2014; Sheriff and Amoako, 2014; Amuakwah-Mensah and Marbuah, 2015) the present paper differ from these ones for the following reasons. First, it introduces money growth and a measure of institutional quality in determining interest rate spread. These variables have not been considered in previous studies on Ghana. Broad money growth creates inflationary pressures. This increases risk that requires larger interest rate spreads to reduce bank losses. Good institutional quality is expected to among others provide adequate monitoring, regulation and evaluation to ensure the financial industry is efficient and effective. Secondly, it makes use of exchange rate volatility, deposit interest rate volatility, and lending interest rate volatility. These variables measure macroeconomic instability and are important as macroeconomic instability increases risks and uncertainties faced by the financial sector, requiring increases in interest rate spreads to reduce possible bank losses.

The rest of the paper is structured as follows: The next section discusses the model and methodology adopted for the study. Section three analyzes the estimation results obtained while the final section shows the implications of the study and offers the concluding remarks.

2.0 Methodology

2.1 Model specification and data

To examine macroeconomic determinants of interest rate spreads in Ghana, the paper adopts the equation specified below:

$$\ln IRS_t = \beta_0 + \beta_1 \ln INF_t + \beta_2 EER_{vol}_t + \beta_3 DR_{vol}_t + \beta_4 M2_g_t + \beta_5 \ln MP_t + \beta_6 PT_t + \beta_7 DEF_t + \beta_8 \ln Y_t + \beta_9 \ln CROWD_t + \beta_{10} LR_{vol}_t + \varepsilon_t \quad (1)$$

where IRS , INF , EER_{vol} , DR_{vol} , and $M2_g$ represent interest rate spread, inflation, exchange rate volatility, deposit interest rate volatility, and broad money growth respectively. MP , PT , DEF , Y , ε indicate monetary policy rate (i.e. the prime rate), institutional quality (proxied by Polity2), fiscal deficits, real GDP per capita, and the error term respectively. $CROWD$ and LR_{vol} refer to public sector borrowing from commercial banks (crowding-out) and lending interest rate volatility respectively. \ln is the natural log operator while t shows the time-variant nature of the data used. Fiscal deficit is defined as overall balance including grants and net lending but excluding divestiture receipts and liabilities expressed as a percentage of GDP. The dependent variable (interest rate spread) is calculated as *Lending interest rate minus Deposit interest rate*. Exchange rate, lending interest rate, and deposit interest rate volatilities are calculated using the GARCH (1, 1) approach. $CROWD$ is measured as *Domestic credit provided by the financial sector minus Domestic credit to private sector by banks*. $CROWD$ is introduced to measure the extent of public sector involvement in the banking sector or “crowding-out” effect of government intervention in the banking sector. Inflation is measured as consumer price index. β_1 is expected to be positive and statistically significant since it reflects the cost of doing business in the banking sector. Specifically, higher inflation is expected to cause higher inflation-adjusted interest rate spreads if it makes banks charge risk premiums. β_2 is also expected to be positive and statistically significant since increasing macroeconomic instability raises the risks faced by banks. β_3 , and β_9 , may be positive or negative. This is explained by the fact that, given the definition of interest rate spreads, the effects of lending and deposit interest rate volatility on

spreads at any point in time depends on which of the two dominates the other. β_4 , β_5 , β_7 , and β_{10} are expected to be positive and statistically significant. Broad money growth increases financial sector risk premium which necessitates increases in interest rate spreads. Increasing monetary policy rate increases cost of funds which widens interest rate spreads. Fiscal deficits and public sector borrowing from commercial banks are expected to increase interest rate spreads through their crowding-out effects. β_6 , and β_8 are expected to be negative and statistically significant. Quality institutions are associated with good institutional, legal, and regulatory framework which enables them reduce interest rate spreads. Finally, economic growth is expected to reduce interest rate spreads since it provides better technology, increases competition, and provides greater mix of financial opportunities. Annual data for the period 1980-2013 was used. Data on lending interest rate, inflation, exchange rate and deposit interest rate are obtained from the International Monetary Fund (IMF), International Financial Statistics (IFS) data set, 2015. Data on broad money growth and monetary policy rate (i.e. the prime rate) were obtained from the Bank of Ghana. Real GDP per capita and public sector borrowing from commercial banks is sourced from the World Development Indicators (WDI, 2015). Fiscal deficit is sourced from African Development Indicators 2007 CD-ROM (for 1980-2005), World Development Indicators (WDI, 2015), and the Bank of Ghana Statistical Bulletins (various issues, for 2006-2013). Data on Institutional quality is obtained from Polity IV Project, Marshall and Jaggers (2014). A summary of the data type and sources are given in Table 7.

2.2 Estimation strategy

The estimations begin with an investigation of the stationarity properties of the variables in equation (1). The parametric Augmented Dickey-Fuller (ADF) method by Dickey and Fuller (1979; 1981) and the non-parametric Phillips-Perron (PP) procedure by Phillips and Perron (1988) are used. Examining stationarity is particularly important in order to avoid spurious regressions. These procedures are also relevant for small sample size time series data such as this. In addition, the PP test serves as a robustness check on the ADF test results as it is able to correct for higher level serial correlation as well as heteroscedasticity that may be present in the ADF results. By the tests, the null hypothesis of unit root, hence, non-stationarity is examined against the alternative hypothesis of no unit root, implying stationarity in each method.

Following the unit root test, cointegration is examined using the Autoregressive Distributed Lag (ARDL) bounds test approach to cointegration (see Pesaran et al., 2001). The procedure is able to accept series that are strictly $I(0)$ or $I(1)$ or a mixture, provided they are not $I(2)$ or more. It is also appropriate for small sample size estimates (34 observations in this case). The conditional Error Correction Model (ECM) used for the ARDL estimation is stated as:

$$\Delta Y_t = \omega_0 + \sum_{i=1}^k \omega_1 \Delta Y_{t-i} + \sum_{i=0}^k \omega_m \Delta X_{t-i} + \gamma_1 Y_{t-1} + \gamma_m X_{t-1} + \varepsilon_t \quad (2)$$

where Δ represents the first difference operator, m is the number of regressors, and ε_t represents the error term. X and Y are assumed to be the independent and dependent variables respectively. The ECM is estimated by the OLS method.

The null hypothesis of no cointegration ($H_0: \gamma_1 = \gamma_m = 0$) is examined against the alternative hypothesis of cointegration ($H_0: \gamma_1 \neq \gamma_m \neq 0$) using the F-test. The bounds test provides the upper and the lower critical values for evaluating the presence or otherwise of cointegration. The

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3 upper bound critical value assumes all variables to be $I(1)$ while the lower bound critical value
4 assumes them to be $I(0)$. There is cointegration when the estimated F-statistic is greater than the
5 upper bound critical value while no cointegration exists when the estimated F-statistic is less
6 than the lower bound critical value. Inconclusive results for cointegration emerge when the
7 estimated F-statistic lies between the upper and lower bound critical values. Long-and short-run
8 estimates are obtained provided evidence for cointegration emerges. The test is done using
9 EViews 9.
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12 **3.0 Estimation results and discussion**

13 **3.1 Unit root and cointegration results**

14 The unit root test results for the variables in equation (1) are given in Tables 1 and 2. Table 1
15 contains the ADF unit root test results while Table 2 contains that for PP.
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19 **INSERT TABLE 1 HERE**

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21 It is evident from the ADF and PP test results that the variables in equation (1) are either
22 integrated of order zero (i.e. $I[0]$) or one (i.e. $I[1]$), irrespective of whether the test is done with a
23 constant and trend or with a constant but with no trend. Hence, the variables in equation (1) are a
24 mixture of $I(0)$ and $I(1)$ variables. Therefore, the ARDL method for examining cointegration
25 becomes appropriate following the unit root results obtained.
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28 **INSERT TABLE 2 HERE**

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30 The results for the ARDL bounds test for cointegration reported in Table 3 indicates
31 cointegration at 1 per cent level. The reason is that, the test statistic of 9.862914 is greater than
32 the upper bound critical value of 3.86 at 1 per cent level of significance. Therefore, there is
33 indeed a valid cointegration relationship between the variables estimated using equation (2).
34 Hence, we move on to provide and discuss the results of the long-and short-run estimates.
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39 **3.2 Estimated long-run**

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41 The long-run estimates of the macroeconomic determinants of interest rate spreads are given in
42 Table 4. The coefficient of exchange rate volatility is positive and statistically significant at 5 per
43 cent level. Hence, an increase in exchange rate volatility leads to increases in interest rate
44 spreads. This is expected as increasing exchange rate volatility creates greater uncertainty,
45 leading to banks fixing higher risk premiums which eventually increases interest rate spreads by
46 increasing lending rates. Besides, exchange rate volatility is an indicator of macroeconomic
47 instability which increases the levels of risks faced by commercial banks. This causes
48 commercial banks to vary their pricing attitudes which lead to increased interest rate spreads.
49 Similar result is reported by Chirwa and Mlachila (2004) for Malawi and Folawewo and Tennant
50 (2008) for sub-Saharan African countries.
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3 The coefficient of deposit interest rate volatility is also positive. Deposit interest rate volatility
4 increases uncertainty with respect to expected profit margin. Banks therefore respond by
5 increasing lending rates. This causes interest rate spreads to increase. Similar evidence is
6 provided by Brock and Suarez (2000) for Latin America.
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9 Lending rate volatility also has a negative relationship with interest rate spreads, implying
10 increasing lending interest rate volatility reduces interest rate spreads. The coefficient of the
11 lending rate volatility variable is however statistically insignificant. Brock and Suarez (2000)
12 find similar evidence for Colombia.
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15 As expected, the coefficient of the institutional quality variable, PT is negative and statistically
16 significant at 1 per cent level. The implication is that, good institutional quality reduces interest
17 rate spreads. This is so since regulation and enforcement are easier under such conditions.
18 Moreover, a level playing field is created under such circumstances which encourage
19 competition, causing spreads to reduce. Chirwa and Mlachila (2004), Crowley (2007), and Adu
20 et al. (2013) emphasize the importance of quality institutions in controlling interest rate spreads.
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23 The coefficient of the fiscal deficit variable shows a positive relationship between fiscal deficit
24 and interest rate spreads. The coefficient is statistically significant at 1 per cent level. This may
25 be so because deficits cause greater public involvement on the local financial markets which
26 eventually increases interest rate spreads through increasing lending rate. Continues domestic
27 borrowing to finance fiscal deficits is therefore likely to continually increase interest rate spreads
28 (see ISSER, 2013; Bawumia, 2014). The results confirm that provided by Aisen, and Hauner,
29 (2008) for a panel of 60 advanced and emerging countries and Laubach (2009) for U.S.A.
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33 The coefficient of economic growth, Y, is positive and statistically significant at 1 per cent level.
34 It is the largest long-run driver of interest rate spreads per the estimated results. The positive
35 impact of economic growth on interest rate spreads is explained as follows. Economic growth
36 causes more specialized financial institutions to emerge. As financial institutions become more
37 and more specialized, the financial market deepens. This causes riskier borrowers to emerge as it
38 becomes easier to access funds. Unfortunately, riskier borrowers tend to have better access to
39 funds since such borrowers mostly pay higher interest rates. This increases financial sector risk
40 premiums. Increases in risk premiums are transmitted to higher lending rates, eventually leading
41 to greater interest rate spreads. This may occur if the portion of bank loans devoted to retail as
42 well as specialized lending is relatively large, leading to larger interest rate spreads not
43 dependent on lending rates (Demirguc-Kunt and Huizinga, 1999). Moreover, as stated by
44 Demirguc-Kunt and Huizinga (1999) the level of economic growth in any country is an indicator
45 of the differences in banking technology as well as the mix of banking opportunities that may be
46 available. If the level of banking technology and the mix of available banking opportunities vary
47 greatly among commercial banks, interest rate spreads is likely to increase with economic growth
48 (Demirguc-Kunt and Huizinga, 1999). This may also explain the results obtained here as the
49 situation in Ghana is not different. The reason is that Ghana's financial system is currently
50 diversified in terms of the range of services it provides. In addition, financial institutions are
51 becoming increasingly innovative with new products and technology. Entry has been liberalized
52 which has encouraged foreign financial institutions and investors to enter. This has increased
53 competition among financial institutions, and introduced strong business practices, and risk
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management systems which may be creating higher spreads (Bank of Ghana, 2007; Adu, et al., 2013; Ackah and Asiamah, 2014). Crowley (2007), Ben Naceur and Goaid (2008), and Garr and Kyereboah-Coleman (2013) provide similar results for sub-Saharan African countries, Tunisia and Ghana respectively.

Even though the coefficients of broad money growth, monetary policy rate, and public sector borrowing from commercial banks are positive, they are however not statistically significant. It was expected that money growth, monetary policy rate, and public sector borrowing from commercial banks increase interest rate spreads. This is so since broad money growth creates inflationary pressures which increases risk premium and hence interest rate spreads. Monetary policy rate, on the other hand, increases cost of funds which may be passed on as increased lending rates that eventually increase interest rate spreads. The positive coefficient of the public sector borrowing from commercial banks variable indicates government intervention in the banking sector likely crowds-out credit to the private sector. Competition for credit is stifled and this causes lending rates to soar, which increases interest rate spreads. This is because banks find it more lucrative to lend to government compared to private borrowers, given that government is less likely to default on loans. Folawewo and Tennant (2008) provide similar evidence on broad money growth for Sub-Saharan African countries while Churchill et al. (2014) corroborates the results for the monetary policy rate variable for Ghana. The results for the public sector borrowing from commercial banks variable confirms that of Folawewo and Tennant (2008) for Sub-Saharan African countries but contradicts those of Garr and Kyereboah-Coleman (2013) and Sheriff and Amoako (2014) for Ghana. Finally, the long-run coefficient of inflation is positive but statistically insignificant. Naceur and Goaid (2008), and Churchill et al., (2014), and Amuakwah-Mensah and Marbuah (2015) find similar evidence for Tunisia and Ghana respectively.

3.3 Short-run results

The short-run results are presented in Table 5. The coefficients of inflation, deposit interest rate volatility, fiscal deficit, public sector borrowing from commercial banks, lending rate volatility, exchange rate volatility, broad money growth, institutional quality, as well as economic growth do not differ in sign from those of the long-run. However, only the short-run coefficient of exchange rate volatility, fiscal deficit, public sector borrowing from commercial banks, and lending rate volatility are statistically significant. In the short-run, the monetary policy rate variable is negative and statistically significant at 5 per cent level.

INSERT TABLE 5 HERE

The paper examines the adequacy and reliability of the ARDL model by considering their statistical properties. The results are given in Table 6. The paper examines serial correlation using Breusch-Godfrey LM test, heteroscedasticity using the Breusch-Pagan-Godfrey, and normality using Jarque-Berra test. The results show the model passes all these diagnostic and reliability tests. Further, model stability tests done using the CUSUM and CUSUMSQ statistic indicates the model is stable over the period considered. The error correction term [ecm(-1)] is negative and statistically significant at 1 per cent level. It shows a very high rate of convergence annually to long-run equilibrium after every short-run shock. Specifically, 89 per cent of short-

run shocks are corrected annually. The error correction term also confirms the cointegration relationship stated earlier which further shows that the long-and short-run results are not spurious.

INSERT TABLE 6

4.0 Concluding remarks

The paper has investigated macroeconomic determinants of interest rate spreads in Ghana for the period 1980-2013. The autoregressive distributed lag bounds test to cointegration was used for the estimation. Macroeconomic variables considered were exchange rate volatility, lending interest rate volatility, public sector borrowing from commercial banks (crowding-out effect), deposit interest rate volatility, economic growth, fiscal deficit, inflation, monetary policy rate, and a measure of institutional quality. The test for cointegration shows evidence of cointegrating relationship between these variables. The long-run estimates indicate inflation, fiscal deficit, crowding-out effect, exchange rate volatility, deposit interest rate volatility, economic growth, money growth, and monetary policy rate increase interest rate spreads in Ghana. However, only the long-run coefficient of exchange rate volatility, fiscal deficit, public sector borrowing from commercial banks, and economic growth were statistically significant. Institutional quality and lending interest rate volatility were found to reduce interest rate spread in the long-run, but the coefficient of the lending interest rate variable was not statistically significant. From the short-run results, inflation, exchange rate volatility, deposit interest rate volatility, money growth, fiscal deficit, economic growth, public sector borrowing from commercial banks (i.e. crowding-out effect) increase interest rate spreads, but only the coefficients of exchange rate volatility, fiscal deficit, and public sector borrowing from commercial banks were statistically significant. The short-run coefficients of the institutional quality variable, monetary policy rate, lending rate volatility were negative, but the coefficient of the institutional quality variable was not statistically significant.

From the results, all fiscal policy variables (public sector borrowing from commercial banks, and fiscal deficits) were statistically significant in both the long-and the short-run. On the other hand, for monetary policy variables, only the coefficient of exchange rate volatility was statistically significant in the long-run while only the coefficients of exchange rate volatility, monetary policy rate, and lending interest rate volatility are statistically significant in the short-run. It can therefore be said that the effects of fiscal policy variables on interest rate spreads dominate monetary policy variables. This implies instabilities in fiscal policy variables are likely to create greater risks and uncertainties in the financial sector which may translate into higher interest rate spreads. Notwithstanding, the nation's monetary and fiscal policy authorities must put in place necessary policies to control macroeconomic instability in general since such instabilities are associated with risks and uncertainties which necessitate wider interest rate spreads. Also, the central government must reduce its borrowing from domestic financial institutions since the crowding-out effect associated with such borrowing increases interest rate spreads. The central bank must put in place appropriate measures to control the depreciation of the Ghana Cedi since the volatility of the domestic currency increases interest rate spreads. The central government must control its excessive spending since the fiscal deficits that arise from it increases interest rate spreads. The results of the institutional quality variable imply quality institutions can better reduce interest rate spreads. Given this, the central bank must improve its monitoring and evaluation measures to ensure banks comply with policy-determined interest rates.

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Tables

Table 1: ADF Unit root test results

Variables	Levels		First Difference	
	Constant	Constant and Trend	Constant	Constant and Trend
<i>LN IRS</i>	-1.392	-3.857**	-8.973***	-
<i>LN MP</i>	-1.780	-1.920	-7.253***	-7.341***
<i>LNCROWD</i>	-2.541	-2.605	-5.759***	-5.674***
<i>LN INF</i>	-3.489**	-5.184***	-	-
<i>EER_{vol}</i>	3.832	3.105	3.812	0.654
<i>M2_g</i>	-4.713***	-5.370***	-	-
<i>DEF</i>	6.742	5.487	2.231	1.128
<i>PT</i>	-1.056	-8.874***	-12.130***	-
<i>DR_{vol}</i>	-2.912	-3.026	-5.433***	-5.329***
<i>LNY</i>	3.010	-0.203	-4.708***	-5.833***
<i>LR_{vol}</i>	-3.132**	-3.071	-	-6.222***

Source: Authors

Note: ***(**)(*) denotes significance at 1%, 5% and 10% respectively

Table 2: PP unit root test results

Variables	Levels		First Difference	
	Constant	Constant and Trend	Constant	Constant and Trend
<i>LN IRS</i>	-2.377	-3.877**	-9.075***	-8.919***
<i>LN MP</i>	-1.731	-1.817	-7.158***	-7.367***
<i>LNCROWD</i>	-2.621*	-2.728	-6.063***	-5.940***
<i>LN INF</i>	-3.387**	-5.356***	-	-
<i>EER_{vol}</i>	1.690	-1.200	-10.205***	-12.935***
<i>M2_g</i>	-4.725***	-11.161***	-	-
<i>DEF</i>	18.403	14.521	-7.889***	-9.315***
<i>PT</i>	-1.170	-7.320***	-13.591***	-12.848***
<i>DR_{vol}</i>	-2.170	-2.214	-5.767***	-5.449***
<i>LNY</i>	3.010	-2.422	-2.711**	-3.398**
<i>LR_{vol}</i>	-3.136**	-3.075	-	-8.067***

Source: Authors

Note: ***(**)(*) denotes significance at 1%, 5% and 10% respectively

Table 3: ARDL bounds test for Cointegration

Test Statistic	9.862914***
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Source: Authors

Note: *** implies that the null hypothesis of no cointegration is rejected at 1 per cent level of statistical significance. The ARDL model gives the 99 per cent lower and upper bounds as 2.54 and 3.86 respectively.

Table 4: Estimated long-run results using ARDL approach

Variable	Coefficient	Standard Error
<i>lnINF</i>	0.100	0.098
<i>EER_{vol}</i>	2.161**	1.002
<i>DR_{vol}</i>	0.004	0.002
<i>M2_g</i>	0.008	0.008
<i>lnMP</i>	0.262	0.152
<i>PT</i>	-0.362***	0.085
<i>DEF</i>	0.000135***	0.020
<i>lnY</i>	11.433***	2.066
<i>lnCROWD</i>	0.993**	0.345
<i>LR_{vol}</i>	-0.000751	0.001
<i>C</i>	-73.231***	13.892

Source: Authors

Notes: *lnIRS* is the dependent variable. ***(**)(*) indicate rejection of the null hypothesis at 1(5)(10) per cent level of statistical significance respectively.

Table 5: Estimated short-run results using ARDL approach

Variable	Coefficient	Standard Error
$\Delta lnINF$	0.089	0.165
ΔEER_{vol}	1.376***	0.484
ΔDR_{vol}	0.002	0.001
$\Delta M2_g$	0.001	0.005
ΔPT	-0.054	0.061
$\Delta lnMP$	-0.862**	0.430
ΔDEF	0.000021***	0.003
ΔlnY	4.084	3.119
$\Delta lnCROWD$	0.452**	0.197
ΔLR_{vol}	-0.002**	0.001
<i>ecm(-1)</i>	-0.890***	0.203

Source: Authors

Notes: *lnIRS* is the dependent variable. ***(**) indicate rejection of the null hypothesis at 1 per cent (5 per cent) level of statistical significance respectively.

Table 6: Model reliability and stability tests

Test statistic	Results
Serial correlation	0.453013 (0.5162)
Normality	0.857118 (0.651447)
Heteroscedasticity	1.586351 (0.2173)
CUSUM	Stable
CUSUMSQ	Stable

Source: Authors

Note: In parentheses are probability values

Figure 2: CUSUM and CUSUMSQ diagrams for the general model

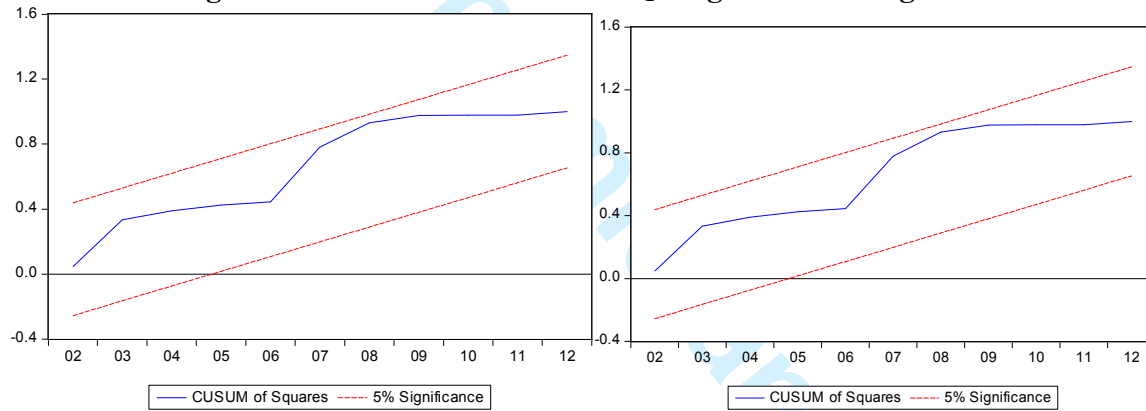


Table 7: Summary of data type and sources

Variable name	Measure	Expected sign	Source
Interest rate spread	<i>Lending interest rate minus Deposit interest rate</i>		International Monetary Fund (IMF), International Financial Statistics (IFS) data set, 2015
Inflation	Consumer price index	+	International Monetary Fund (IMF), International Financial Statistics (IFS) data set, 2015
Exchange rate volatility	Derived from nominal exchange rate using the GARCH (1, 1) approach	+	International Monetary Fund (IMF), International Financial Statistics (IFS) data set, 2015
Deposit interest rate	Derived from deposit interest rate using the GARCH (1, 1) approach	+/-	International Monetary Fund (IMF), International Financial Statistics (IFS) data set, 2015
Broad money growth	Average annual growth rate in money and quasi money	+	Bank of Ghana
Monetary policy rate	Prime rate	+	Bank of Ghana
Institutional quality	Polity2	-	.Polity IV Project (Marshall and Jaggers, 2014)
Fiscal deficit	Overall balance including grants and net lending but excluding divestiture receipts and liabilities expressed as a percentage of nominal GDP	+	African Development Indicators 2007 CD-ROM (for 1980-2005), World Bank, and the Bank of Ghana Statistical Bulletins (various issues, for 2006-2013)
Economic growth	Real GDP per capita	-	World Bank, World Development Indicators (WDI, 2015)
Public sector borrowing from commercial banks	<i>Domestic credit provided by the financial sector minus Domestic credit to private sector by banks</i>	+	World Bank, World Development Indicators (WDI, 2015)
Lending rate volatility	Derived from lending interest rate using the GARCH (1, 1) approach	+/-	International Monetary Fund (IMF), International Financial Statistics (IFS) data set, 2015

Source: Authors