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Effects of Central Bank Independence and Financial Stability on Inflation in Selected African Countries

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This study examines the relationship between central bank independence (CBI), financial stability, and inflation in 14 African countries within the period 1985-2019. Initial test revealed the presence of cross-sectional dependence (CD) among the countries. Thus, the Mean Group (MG), Common Correlated Effect Mean Group (CCEMG) and Augmented Mean Group (AMG) were employed for the analysis. The CCEMG and AMG results showed a significant and negative correlation between central bank independence and inflation. On the other hand, financial stability is only significant in the MG Model. Additional results obtained using the Garriga CBI index is consistent with our main results. The study recommends greater independence of central banks from all forms of political and government influence in order to have greater chance of achieving lower inflation within the African nations.

Keywords: Augmented mean group, central bank independence, common correlated effect mean group, financial stability, inflation, mean group.
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1. Introduction

Price Stability is a key monetary policy objective and central bank independence is widely accepted as a major determinant of lower inflation rate, which is important for financial stability. Independence of the central bank ensures financial stability in addition to its pivotal role of maintaining price stability(Das & Quintyn, 2004). Financial stability ensures smooth operations among the various components of the financial system. Regulatory and supervisory independence (RSI) is a complementary role performed by the central bank over other financial institutions, market, as well as payment, settlement and clearing systems to achieve financial stability. Moreover,

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central banks use monetary policy to maintain low and stable inflation and exchange rate to ensure financial stability.

Empirical literature suggested that independence of central bank may result to price stability (Cihak, 2007; Cukierman, 2008; Klomp & De Haan, 2007). It is also argued that financial stability may be enhanced through central bank independence. RSI from industry and government are vital towards the achievement and preservation of financial stability (Cihak, 2007; Garcia & Del Rio, 2003). Following the seminal contributions of Kydland *et al.* (1977), Barro and Gordon (1993) and Rogoff (1985), central bank independence is viewed primarily as a means to mitigate an inflation bias that may emerge under discretionary policy (Acemogluet *et al.* 2008).

Monetary policy makers are accorded freedom from any form of government or political influence in the process of carrying out their functions through the independence of central bank (Walsh, 1995). Despite being a widely researched area, financial instability still poses a great threat to the economy of most emerging and developing African countries. Although some institutions are saddled with the responsibilities of maintaining financial stability within the economy, the supplementary role played by central bank independence is eminent. A clear demarcation between authorities charged with issuing currency from the authorities supervising its disbursement, helps the central bank to focus on achieving price stability (Agoba *et al.* 2017).

Inflation rate increase in emerging countries has been more pronounced in the recent past. Many countries recorded double-digit rate as the trend remained unchecked. This is a great source of concern to the African region in particular and is largely attributed to inflationary bias borne out of discretionary policies of government which is being exhibited by institutions vested with monetary policy functions. Institutional change could be necessitated by this development. The change in the institution depends on the conviction that independence of the monetary policy from state authority can help in the realization of the objective of price stability. The independence of central bank get support from theories in the work of Barro and Gordon (1993). They confirm that central bank independence enhances the effectiveness of the non-inflationary policy. Thus, increasing central bank independence helps in minimizing inflation rate.

Cukierman (1992) posits that correlation between statutory CBI and inflation is not significant in developing economies and it is largely attributed to broad differences between real practice and stipulated statutory provisions. This resulted to a debate in recent time among scholars that while independence of central bank is very instrumental to achieving stable inflation rate in developed countries, it is yet to receive adequate attention among researchers in developing and emerging economies of Africa (Hielscher & Markwardt, 2012; Klomp & Haan, 2007; Klomp & Haan, 2010; Posen, 1993).

Economic theorists hold that a strong democratic institution with proven integrity increase the rate of CBI to maintain price stability and also achieve the benefit related with a stable and low inflation rate (Bodea & Hicks, 2014). Moreover, large number of empirical studies indicate that the benefit of increased CBI is evident regardless of the level of economic growth and development of a country(Landstrom, 2013). Furthermore, it has been confirmed that CBI does not only aid in sustaining price stability but also ensures financial stability (Arnone *et al.* 2007; Bernanke, 2010).

Studies on the relationship between CBI and inflation from emerging and developing economies particularly from Africa are limited. A number of research focuses on the effect of CBI on financial stability. Cihak (2007) argues that separating monetary policy from political pressures signifies that central bankers are less restricted from acting proactively to safeguard financial crises. He also offers some primary empirical results in support of the view that CBI fosters financial stability. A study by Garcia and Del Rio (2003) reveals that higher values of CBI indicators are related with a lower likelihood of a banking crises. On the other hand, Klomp and De Haan (2007) found a negative relationship between CBI and financial instability.

The objective of the research study is to examine the effect of Central Bank Independence and financial stability on inflation in 14 selected African countries for a period between 1985 to 2019 using second generation hetrogeneous panel data approach that controls for cross sectional dependence among countries.

This study is motivated by persistent rise in the price of goods and services across African countries with a limited hope in checking the inflation rate coupled wih the

fact that institution responsible for ensuring the stability of prices and effective monetary policy implemetation are not living up to expectation. There is a wide gap between developed and developing countries in respect to central bank independence. This is one of the few studies which look at the effect of central bank independence and financial stability on inflation in selected African countries. Moreover, the study used the Cukierman CBI index in the baseline model and the Garriga CBI index in checking robustness, which constitute one of the major differences between the current and previous studies that mainly focus on one of the indices.

The remainder of the paper is structured as follows; Section 2 covers the literature review. Section 3 contains data and methodology. In Section 4 empirical result and discussions are presented, and Section 5 discusses the conclusion and policy implications.

2. Literature Review

This section explains the theoretical and empirical literature establishing the relation between CBI and inflation on one hand, and CBI, financial stability and inflation rate on the other hand.

2.1 Theoretical Literature

The evolution of dynamic inflation theory starts by linking wage inflation and unemployment. In further advancement, the backward-looking and forward-looking inflation expectations factors were categorized into the inflation model. Changes in inflation are not totally driven by different countries inflation forecasts. The output gap, changes in the money supply, exchange rate and monetary parameters such as central bank independence are thought to have affected variations in inflation. Following the 2008-09 global financial crisis, governments increased central banksmain objectives, functions and responsibilities beyond their original mandate in an attempt to control the crisis (Balls *et al.* 2018; Rogoff, 2019; Dall'Orto Mas *et al.* 2020). Using a New-Keynesian Phillips Curve (NKPC) model, this paper examines the influence of CBI and financial stability on the dynamics of inflation in 14 African countries.

A classical insight into monetary theory is advanced by the well-known theory of

money known as QTM (quantity theory of money). The theory stated that traditional function of money was neutral. The fundamental premise of current monetary theory is that inflationary pressures are determined by the amount to which economic capabilities are the under-employment or over-employment of resources (Strong, 2021). This indicates that there is no chance of consistently high inflation as long as the economy is working toward full capacity utilization. However, modern monetary theory advocates have subsequently modified the idea, stating that there are other drivers of increasing inflation that are not represented in the overall level of demand. Classical theory on the other hand holds that the price level is positively related to monetary wages. It is asserted that doubling the amount of money doubles the price level and that changes in the money supply may cause a relative shift in the price level (Fisher). According to the Fisher effect, the market interest rate equals the actual interest rate plus the anticipated rate of change in prices.

Monetarists on the other hand think that monetary expansion will raise the price level in the long run since doubling the money supply will double the price level in the long run and the real interest rate will not change. Monetarists also think that monetary growth can only have a short-term impact on economic activity. However, alternative postulates have always resulted in the consolidation of new economic theories. Keynesian economics rose to prominence. Friedman's concepts were developed in reaction to the "Great Depression" of the 1970s, and they have since been increasingly used to address the dynamic nature of inflationary effects on economies across nations.

As a result, it is critical to examine the impact of central bank independence and financial stability on inflation. The central bank's approach to an inflationary scenario is to dramatically increase interest rates, making it more difficult for the government to correct its deficit; this move may cause some conflict. For example, prior to the 2008 financial crisis, central bank duties mostly involved bank supervision, which was done at the individual institution level. However, the global financial crisis emphasized the significance of monitoring sources of systemic risk, therefore central banks' mandates were considerably broadened in many countries to encompass the larger goal of financial stability. CBI is protected under the constitution in certain

nations but not in others. When a government spends a lot of money, inflation begins to rise. If it controls the central bank, this is not an issue. If it does not, the latter is likely to tighten monetary policy in order to alleviate inflationary pressures. This implies that fiscal policy will be less successful under CBI (Bodea & Higashijima 2017; Clark & Hallerberg 2000). Therefore, New-Keynesian Phillips Curve (NKPC) will be adopted to build our model in addressing the systemic increase in inflation pressure by considering the role of financial stability and CBI.

2.2 Empirical Literature

Extensive research conducted on the relationship between central bank independence and inflation remained inconclusive. While a large number of scholars like Garriga and Rodriguez, (2020), Kokoszczyński and Mackiewicz-Łyziak, (2020), and Posso and Tawadros, (2013) hold that the relationship between CBI and inflation is negative, others like Chrigui et al. (2011) and He and Zou, (2019) believe that such association revealed a positive outcome. Insignificant result is also obtained from an empirical study by Martin (2015). The discrepancies obtained from the findings of the study were largely due to the measurement of CBI. While some employed the Cukierman CBI index, others used the Garriga CBI index. Moreover, the context of the studies contributed a lot as most of the studies focused in advanced countries with few from emerging economies. This study uses both indices with Cukierman index in the main model, and Garriga index in the robustness model.

Studies on the relationship between inflation and CBI reported mixed findings. Ever since the seminal work of Kydland *et al.* (1977) and Barro and Gordon (1993) on the inconsistency of the dynamic time, the support for the greater independence of central bank needed to manage inflation is seen as an institutional necessity for the effective and efficient implementation of monetary policy. In addition, Rogoff (1985) is also of the opinion that the application of stringent policy and CBI result to lower and stable price than less stringent and independent central banks.

Crowe and Meade (2008) examined the relationship between central bank independence and transparency in achieving price stability. The results indicated a nonexistent or weak association between CBI and inflation. Klomp and Haan (2009) evaluated the relationship between central bank independence and financial instability.

The result indicated a robust and significant negative association between financial stability and CBI. Moreover, in a study conducted by Chrigui *et al.* (2011), on the correlation between CBI and inflation from emerging economies, revealed a positive and non-significant relationship between CBI and inflation.

Brumm (2011), analyzed the relationship between inflation and CBI. Findings from the study indicated a negative relationship between CBI and Inflation. Posso and Tawadros, (2013), show that CBI independence from political influence is imperative to curtail inflation. Their results confirmed the inverse relationship between CBI and inflation.

Arnone and Romelli (2013) in their study on the dynamic CBI indices and inflation rate, indicated the extent of central bank independence strong influence on the inflation rate. Their findings support the negative relationship between CBI dynamic and inflation. On the other hand, Martin (2015) conducted a research on the relationship between debt, inflation and CBI. Results from the study revealed that independence of central bank in curbing inflation is only effective in the short run but became inactive in keeping lower inflation in the long run.

In another study, He and Zou, (2019) employed the monetary Schumpeterian model to evaluate the extent of influence of CBI on inflation. Their study revealed that it cannot predict a monotone relationship between CBI and inflation. They further reveal that when elasticity of labour supply is high, a situation likely associated with developed countries, CBI has a positive impact on inflation; in contrast, when there is inelastic labour supply, situation that is common in developing countries, CBI has a negative or no effect on inflation.

Garriga and Rodriguez, (2020) evaluated the influence of legal CBI on inflation in emerging countries. Finding of the study revealed that lower inflation rate is achieved through higher CBI. Kokoszczyński and Mackiewicz-Łyziak, (2020) examined the relationship between Central bank independence and inflation. The study used the generalized method of moment for the analysis. Result of the study indicated that CBI has a negative and significant effect on inflation. Strong (2021) examined the relationship between political influence, central bank independence and inflation in

Africa. Results from the study showed that higher turnover rate indicates higher inflation. The findings are robust to the decomposition of the turnover rates into yearly removals and quarterly replacements.

Following the findings from studies, the attributes of central bank institution has been adjusted, adapting their objectives or with many revisions, governance, structures and practice to realize more political independence and maintain lower inflation. Large number of researchers have examined the proposition and revealed negative association between CBI and inflation. (Alesina, 1988; Alesina & Summers, 1993; Cukierman *et al.*, 1992; Eijiffinger & de Haan, 1996; Loungani & Sheets, 1997; Berger *et al.*, 2001; Haan & Kooi, 2000; Temple, 1998; Panagrotidis & Triampella 2005).

Meanwhile, there has been growing number of literatures recently that hold contrary opinion. They believe such inverse relationship between inflation and CBI does not exist. Many of these studies according to Posso and Tawadros (2013) suggest that firstly, the significant inverse relationships are obtained by few number of high inflation countries. Secondly, the use of turnover rate as alternative CBI measure gives different findings. Thirdly, the addition of more control variables alters the inverse relationship obtained. Forthly, the relationship could be positive and fifthly, there is absence of causal relationship and the indices of central bank indicated the extent of inflation bias in the economy so that the evident negative association with inflation must hold by contruction.

Managing the monetary policy of a country is one of the key roles of the central bank. The supply of money in the country is controlled by central bank and its usually the primary means of executing monetary policies. Other roles performed by central bank may include formulation of exchange rate policies. The aims of the central bank are mainly to ensure price stability. This implies minimum inflation rate and in some cases stability of exchange rate and full employment (Lassiter *et al.* 2010).

There has been increase in the responsibility of central banks following growing challenges faced by banks in most developing countries. In view of this development, the supervisory function needs to be enhanced, so that there will be interaction between the monetary policy function of the central bank and the supervisory role (Pellegri-

naet *et al.*, 2013). Meanwhile, economic literature have not provided any explicit evidence with respect to optimal ways of supervisory task assignment (Masciandaro, 2009).

On the other hand, Berger and Kibmer (2013) evaluated the relationship between CBI and financial stability. Results from the study show that, central bank is more likely to desist from executing proactive monetary measures towards sustaining financial stability, if given more independence. Hence, their result is in disagreement with popular views that CBI enforces financial stability. Haan *et al.*, (2018) finds that proxies of CBI do not provide sufficient evidence that CBI has declined following the financial crisis. The only factor is the rise in central bank governors turnover rate in developed economies.

The central bank is an embodiment of the state monetary authority. Serving as lender of last resort and liquidity sources, the management and prevention of banking crises are part of the commitment of central bank (Goodhart, & Shoenmaker, 1995; Masciandaro, 1995; Bernanke, 2007; Blanchard *et al.*, 2010; Blinder, 2010). Moreover, it facilitates financial stability in close co-ordination with agencies of the government (Nowotny *et al.*, 2010; Angelini *et al.* 2012).

The commitment of the central bank on banking supervision was a result of economies of scale and other information advantage which they have over complimentary institutions charged with the task of maintaining optimal liquidity and sustaining financial stability of institutions under their control (Ferguson, 2000; Kaufman, 2000; Pauli, 2000; Bernanke, 2007; Herring & Carmassi, 2008; Klomp, & De Haan, 2007).

Cecchetti and Krause (2001) revealed that an enhancement in the level of financial sector and the transformation stages which is quantified by a liberal central banking has significantly minimized inflation variability, and ensured financial stability. Ma and Lin, (2016) also outlined how the financial system and monetary policy are intertwined. For a variety of reasons, the financial system is crucial when evaluating the relationship between inflation and CBI; the third component argues that the financial resistance to inflation is the cause and effect between CBI and inflation.

The central bank is devoted to its choices and policies as well as the performance of

a supervisory function which outlines its essential aims and principles in upholding the independence requirements placed on them. (Agoba *et al.*, 2017). This makes it possible for the central bank to be truly independent and concentrate on realizing its price and financial stability objectives. The central bank could not achieve as much lower inflation rates and financial stability than it would have in a less advanced financial sector due to issues relating to unemployment that are very much at uncontrollable rate (Mehrotra & Yetman, 2015). Financial stability and stable inflation rate have been noticed from the literature as an important debt markets development precondition. Just like sound public finance, low inflation rate and financial stability of an economy are necessary and also a motivation to attracting investors that are willing to facilitate market development in fixed income securities (Mihaljeket *et al.* 2002).

The focus of most of the previous studies was on developed countries, with a little attention given to developing countries, especially in Africa. Therefore, the study specifically examines the effect of central bank independence and financial stability on inflation among African countries due to the gap that has been established in the literature.

3. Data and Methodology

This section explains the data used in analyzing the relationship between CBI, financial stability and inflation in the selected African developing by drawing out the attributes of the variables in the model and outlining the source of dataset employed.

3.1 Data

The study employs yearly data over the period of 34 years from 1985 to 2019. The variables used include Real GDP, inflation rate, financial stability and central bank independence (CBI). Inflation rate is collected from International Financial Statistics (IFS, 2020) statistical database as computed from consumer price index. The CBI dataset is downloaded as computed from Cukierman and Garriga index database. Output gap is obtained by using Hodrick-Prescott (HP) filter calculating the difference between actual and potential output in the economy of each country in line with the underlying theoretical framework of augmented Phillips's curve. The data is obtained from (IFS, 2019).Furthermore, the sum of export and import divided by

GDP is expressed as $opennes_{it}$, while crisis dummy is used to measure STA_{it}using a value that takes 1 for the crisis period and 0 otherwise.the data were obtained from International Monetary Fund (IMF) financial soundness indicators. The dynamics of banking institution behavior, the possible development of unstable situations, and shock transmission mechanisms are the analytical emphasis of the data collection and measurement of financial stability in this article. Similar early warning indicators are used to monitor the state of the banking system, particularly the risk of default of individual institutions, to a broader system-wide assessment of risks to the financial markets, institutions and infrastructure. In this assessment, we use a crisis dummy that includes the values for the years 2008 and 2009, which are classified as crises periods in accordance with Lins *et al.*, (2013), or zero otherwise as applied in the following studies by (Degl'Innocenti, *et al.*, 2018; Bhimjee, *et al.*, 2016). All the variables in the model are converted to natural logarithm. This is because the natural log transformations model stabilizes variance and establishes a normal distribution, frequently successfully correcting numerous violations that would otherwise be needed for conventional least squares regression (Neter *et al.*, 1996). Since the model is predicated on the assumption of ordinary least square that entails stabilizing the variance of the panel data, the variables are converted to natural logarithms in the model to minimize heteroskedasticity and to normalize the data.

The selected African developing and emerging countries are Botswana, Cameroon, Cote Ivoire, Egypt, Ethiopia, Kenya, Morocco, Nigeria, Rwanda, Senegal, South Africa, Tanzania, Tunisia and Uganda. The choice of countries is guided by the scope and high inflation rate, central bank independence, nature of the countries stability in their finances, economic integration, that is, African Union as well as establishment of trade agreement and union among the countries including custom unions, being classified among the developing and emerging economies in Africa (ZhenMin, *et al.*, 2018) and availability of data.

3.2 Theoretical Framework

In analyzing CBI, financial stability and inflation relationships, we modify the New Keynesian Phillips curve. The theoretical model particularly explains the relation-

ship between output gap and inflation rate. The theory postulates a tradeoff between inflation rate and unemployment in the economy by imposing perfectly inelastic restriction as established by Phillips curve theory. In essence, differences between actual and potential output on inflation dynamics can be measured using backward Phillip's curve equations. However, the approach to long run relationship is examined using the New Keynesian model specification of Ball *et al.*, (1988), as outlined in the equation below;

$$\pi_t = \pi_{t-1} + \omega\left(lnX - ln\overline{X}\right) + \varepsilon_t^s\,, \quad \omega > 0 \tag{1}$$

Where inflation is represented by π_t, output gap is $\left(lnX - ln\overline{X}\right)$, and ε_t^s is aggregate supply shock. The output gap is expected to relate positively with inflation, implying that short run inflation effect will increase if actual gap happens to be greater than the expected output or when unemployment is below the natural rate. However, some empirical finding establish that price system is not enough to determine real output and employment, indicating other driving factors that promote stable monetary policy effect, such as higher CBI. Higher CBI is assumed to promote lower inflation that could lead to an increase in real output for an affluent economy. Meanwhile, in adopting the new Keynesian model equation 1 to examine the inflation, CBI and financial stability relationships, the equation is re-parametrized to capture CBI and modified the regressors. Following Brumm (2011), the New Keynesian model is augmented to reflect the approach in inflation-CBI relationship as specified below:

$$\Delta\pi_{it} = \beta_0 \;+\; \beta_1\,\pi_{it-1} + \;\beta_2\,CBI_{it} + \beta_3\;\left(lnX - ln\overline{X}\right)_{it} \tag{2}$$

where β_1, β_2, and β_3 are the expression of coefficient values of lagged inflation rate, CBI, and output gap respectively.

The expected coefficient of CBI in Model (2) is assumed to be negative (Brumm, 2011; Arnone & Romelli, 2013; Posso & Tawadros, 2013). While specifically the magnitude of the coefficient of the parameters can differ based on the nature of the economy ranging between 0 and 1, with no impact representing 0 and 1 for extreme effect. The closer the coefficient to 0, the lower the degree of the impact. However, when the degree is higher, the coefficient tends toward 1.

3.3 Model Specification

For the study, we create a dynamic inflation model in which the CBI is first regressed on inflation. By enhancing the new Keynesian model, we assess the impact of CBI on inflation using the Brumm (2011) method. Model 2 is adopted for a specified CBI-inflation model, including additional variables of real GDP (rgdp), real exchange rate (rexchr), openness (opn), and financial stability (sta), which are consistent with previous studies on CBI-inflation. The adoption of the model has become a commonly applied practice in most empirical studies as a required instrument for measuring the relationship between inflation and CBI. The main interest lies in the effects of CBI and financial stability on inflation. We specify the model using different measures of CBI index: the Cukierman index for baseline model estimation and the Garriga index for robustness check. The functional form of the model is presented as:

$$infl_{it} = f(CBI_{it},\ rgdp_{it},\ r\_exchr_{it},\ OPN_{it},\ STA_{it}\ ) \tag{3}$$

The econometric model is expressed as:

$$infl_{i,t} = \beta_0\ +\ \beta_1\ CBI_{i,t} + \beta_2\ rgdp_{i,t} + \beta_3\ r\_exchr_{i,t} + \beta_4\ gap_{i,t} + \beta_5\ OPN_{i,t} + \beta_6\ STA_{i,t} + \xi_{i,t} + \eta_{i,t} + \varepsilon_{i,t} \tag{4}$$

$$(\beta_2, \beta_3,\ \beta_4,\ \beta_5, \beta_6 < 0)$$

where $infl_{it}$ is the annual inflation rate, defining a changing dynamics resulting to a persistence increase of inflation, CBI_{it} is the Cukierman changes in central bank objective, $rgdp_{it}$ is annual real GDP growth rate, $rexchr_{it}$ is express as real effective exchange rate, gap_{it} is the output gap , OPN_{it} is is trade openness, and $STA_{it}$is the measure of financial system stability, $\xi_{i.t}$ is a period-specific constant to account for common shocks; $\eta_{i.t}$ is an unobserved country-specific effect that captures all time-invariant factors that affect the outcome; and $\varepsilon_{i.t}$ is the error term, CBI, real effective exchange rate, trade openness, real GDP and financial stability are expected to have negative relationship with inflation. To standardize the data and make it more linear so that estimators may be made BLUE, the variables are changed to natural logarithms. This suggests that some of the core properties of a panel data are preserved

by a logarithmic modification. A dataset that is strictly growing with time in terms of its level values will continue to be strictly increasing when altered by taking the natural log. A data series that undergoes exponential expansion will also experience linear growth in terms of its natural logarithms.

3.4 Estimation Procedure

The second-generation econometric techniques—cross-sectional dependency (CSD) test are appropriate for the suggested links between inflation, CBI and financial stability based on the panel data needs and diagnostics. Identification of the variables' stationarity is required after the CSD test (Pesaran 2015). The CADF (Pesaran 2007), CIPS tests and slope heterogeneity test are used for this purpose since they are capable of handling the CSD and slope heterogeneity issue. Then, co-integration estimation is used (Westerlund 2007).The application of panel data is to examine long run effects of CBI and financial stability on inflation using second generation estimation techniques such as Mean group (MG) Pesaran and Shin (1999), Common Correlated Effect Mean Group (CCEMG) Pesaran (2006) and Augmented Mean Group (AMG), Eberhadt and Bond, (2009) and Eberhadt and Teal (2010). For example, random or fixed effect and a traditional method of generalized method of moment (GMM) are the few adopted techniques in previous studies; In this study, the techniques involve a separation of regression into separate categories and estimate by averaging the panel data of different groups. In this scenario, MG model offers consistence estimate of the parameters but the presence of homogeneity is not analyzed among the groups in the short run and long run. But CCEMG and AMG as the second generation estimators addresses the issue of cross sectional dependence across countries allows intercept to vary across the groups but restrict slope to be the same. Meanwhile, a mis-leading and inconsistent long run coefficient result is obtained when slopes are to be the same across groups as contended by Pesaran, *et al.,* (2001), particularly in large samples.

When the results of the cross-dependence test, panel unit root test, and cointegration test have proven the existence of heterogeneity and cross dependency, stationarity, and long-run relationships among the variables in the model, the use of second-generation estimators becomes essential and appropriate. In order to examine the models, the AMG estimator (Eberhardt & Bond, 2009), CCEMG (Pesaran, 2006),

and MG estimates (Pesaran & Smith, 1995) needs to be utilized to guarantee that the model's outputs are robust.

Therefore, the research study considers CCEMG and AMG estimation as efficient and vigorous with a varied approach capturing a long run equilibrium as well cross sectionally dependence approach, the speed of adjustment with variance that differs between countries. It is eminent that second generation estimators are seen as appropriate techniques to measure the effects of central bank independence and financial stability on inflation by considering long run effect. In particular,- their economies are assumed to have some common similarities in terms of output growth, financial regulation and policies of the apex banks, but possibly variation may arise in the short run due to local regulations, laws, susceptibility in financial market imperfection and internal as well as external shocks.

Second generation techniques have the advantage of allowing variables in different forms to either be at I(0) or I(1) which explain an error correction model of panel data model to measure the long run effect (Chen, 2009; Salisu & Isah, 2017).

4. Results and Discussion

4.1 Descriptive Statistics

Table 1 explains the summary statistics of the data for 14 African emerging and developing countries between 1985 to 2019. The inflation rate has a mean of 9.213 and a variance of 286.889, a standard deviation of 16.938, a minimum value of -9.146, and a maximum value of 215.400. It is clear from the variance that the inflation rate has the largest level of values, suggesting a significant degree of fluctuation. Similary, the mean of the central bank independence indicated by the CBI is 0.573, with a variance of 0.089, a standard deviation of 0.298, a minimum value of 0.000, and a maximum value of 1.500. Financial stability, on the other hand, has a mean value of 0.116, a variance of 0.103, a standard deviation of 0.321, a minimum value of 0.000, and a maximum value of 1.000. Therefore, among the three important variables of inflation, CBI, and financial stability, inflation has the largest mean, standard deviation, and variance, suggesting a persistent shift in the price level as a consequence of changes in those variables.It can be seen that CBI is positively skewed at 0.624 while real GDP and output gap are negatively skewed at -2.107 and -3.894. Thus, exchange

rate has the highest mean of 117.9, followed by inflation with 9.2.The kurtosis value of 26.536 impliesa higher peak of the distribution from normal for real GDP. Similarly, real exchange rate and financial stability exhibit a longer tail as reported in their distribution being skewed to the right, with kurtosis between 23.892 and 6.728, suggesting apeak above the standard distribution. Exchange rate has a highest mean as well as the standard deviation an indication that inflation will respond quickly to exchange rate fluctuation.

Table 1: Summary Statistics

Variable	Mean	Std. Dev.	Min	Max	Variance	Skewness	Kurtosis	Observation
Infl	9.213	16.938	-9.146	215.400	286.889	7.605	76.025	490
CBI	0.573	0.298	0.000	1.500	0.089	0.624	3.894	490
rgdp	4.314	4.500	-41.890	24.541	20.252	-2.107	26.536	490
rexchr	117.967	54.221	0.000	515.206	2939.879	3.874	23.892	488
gap	0.004	1.541	-19.109	5.766	2.375	-3.893	52.116	490
Opn	4.260	43.677	-341.278	707.059	1907.670	11.070	188.255	490
Sta	0.116	0.321	0.000	1.000	0.103	2.393	6.728	490

We also report the correlation among the variables From the estimates presented in Table 2, CBI, rgdp growth and output gap are negatively correlated with the inflation, while the remaining variables have positive correlation with inflation. The estimated correlation between real exchange rate and inflation is high compared to other variables.

Table 2: Correlation matrix

	Infl	CBI	Rgdp	rexchr	gap	Opn	Sta
Infl	1						
CBI	-0.0967	1					
rgdp	-0.0032	-0.0521	1				
rexchr	0.5822	-0.0704	-0.1214	1			
gap	-0.0709	-0.0005	0.7061	-0.0445	1		
opn	0.0385	-0.0201	-0.0374	-0.018	-0.0467	1	
sta	0.0477	-0.1153	-0.1937	0.0276	-0.0655	-0.0655	1

4.2 Pre-estimation results

4.2.1 Unit root Test

In order to examine the integration levels of the variables, we applied the panel unit root test with cross-sectional augmented IPS (CIPS) test (Im *et al.*, 2003) suggested by Pesaran (2007). Furthermore, the process in using second generation estimators

such as MG, CCEMG and AMG models entails the conduct of other estimations like unit-root and cointegration test in defining the order of integration and cointegrating properties of the variables. The results are shown in Table 3.

The unit root estimates fail to accept the null hypothesis for inflation, real GDP, output gap, openness and financial stability for all the estimates, suggesting non-stationarity. However, the variables became stationary at first difference. The CIPS and CADF findings are shown in Table 2. The cross sectional dependency test shows that all variables under observation are significantly different from zero across panels at a 1% level. The unit root tests show that all variable series are integrated at first order I(1) at a 1% significance level. However, it is important to emphasize that this research model is confirmed for the existence of cross-sectional dependency. To account for this aspect, our panel estimate approach must include panel econometric methods that are efficient, trustworthy, and resistant to the effects of CSD in order to account for possible size distortions. As a result, in accordance, this work employs a set of heterogeneous panel estimate techniques, such as MG, CCEMG, and AMG, which successfully account for the concerns described before.

Table 3: CIPS and CADF unit root test results

	CIPS			CADF		
Variable	Level	1^{st} Diff.	Decision	Level	1^{st} Diff	Decision
infl	-3.368***	-	I(0)	-2.936***	-	I(0)
cbi	-1.72	-4.945***	I(1)	-1.584	-2.970***	I(1)
cbi_garr	-2.026*	-5.302***	I(1)	-1.914	-4.704***	I(1)
rgdp	-4.317***	-	I(0)	-3.389***	-	I(0)
rexchr	-2.911*	-4.976***	I(1)	-2.987***	-	I(0)
gap	-4.683***	-	I(0)	-3.939***	-	I(0)
opn	-5.526***	-	I(0)	-4.297***	-	I(0)
sta	-3.386	-5.222***	I(1)	-3.377***	-	I(0)

Note: ***, **, * denotes significance at 1%, 5% and 10% level respectively, CIPS denote cross-sectional Im, Peseran, and Shin and cross-sectional Augmented Dickey-Fuller tests, respectively.

4.2.2 Cross sectional dependence

Cross-sectional dependence is not given a much satisfactory assessment in most of the previous work with the notion that individual distribution is believed to be cross sectionally dependent (Pesaran, 2007). However, it is now considered an impor-

tant issue to address, which entails the application of a second generation unit root estimation (Moon & Perron, 2004; Choi, 2006; Pesaran, 2007). The estimation is analyzed following different approaches in order to produce a reliable result in determining the level of exposure to different factors in the model, which may result from ”unobserved common factors, externalities, regional and macroeconomic linkages, and un-accounted residual interdependence (Bangake & Eggoh, 2012). However, presence of cross sectional dependence could result to meaningless estimation (spurious result)(Pesaran, *et al.* 2007). We then test for cross sectional dependence using Pesaran (2007).

The result in Table 4 confirms the existence of cross sectional dependence between the countries in our model by rejecting null hypothesis of cross sectional dependence necessitating the adoption of the second generation panel data estimators. This is indicated by the computational value of *opn*.

Table 4: Cross sectional dependence test result

Variable	CD-test	Probability
Infl	11.106***	0.000
cbi	28.858***	0.000
rgdp	6.342***	0.000
r_exchr	11.059***	0.000
gap	3.446***	0.001
opn	-0.270	0.787
sta	7.512***	0.000

Note: CD is cross sectional dependence, ***, **, * denotes significance at 1%, 5% and 10% level respectively.

Tables 4 and 5, show that the model's residuals had dependencies, suggesting a strong economic ties between the countries, defining interdependence among the countries suggesting that any change in a specific characteristic, like urbanization, in one nation was likely to have an impact on the other countries (Musah *et al.*, 2020) and Mensah and Casadevall, (2019). Therefore, heterogeneity test becomes highly essential, without which the estimation might produce inaccurate results. This suggests that accepting heterogeneity could result in using the incorrect econometric methods (Dogan & Aslan, 2017; Erdogan *et al.*, 2020). Heterogeneity in the parameters was validated by test results.

Table 5: Pesaran Yamagata homogeneity test result

Test	Value	Probability
Δ	7.625***	0.000
Δadj.	8.682***	0.000

Note: **, * denotes significance at 5% and 10% level respectively

4.2.3 Panel cointegration test

Table 6: Westerlund panel cointegration test

Statistic	Value	Z-value	P-value	Robust P-value
Gt	-4.1	-4.412	0.000***	0.000***
Ga	-14.517	1.924	0.973	0.000***
Pt	-15.246	-4.842	0.000***	0.000***
Pa	-15.25	0.179	0.571	0.000***

Note: **, * denotes significance at 5% and 10% level respectively; The test statistics are two mean-group tests (Gt and Ga) and two-panel tests (Pt and Pa)

Table 6. Shows the results of the Westerlund panel cointegration test, which determines the existence of cointegration among the variables. Based on the Z-values of the test statistic and their corresponding P-values, Gt and Pt revealed evidence of panel long run relationship among the variables. However, the robust P-values confirm these results in addition to the Ga and Pa statistics that became statistically significant.

4.3 Main Results

First, we estimate three distinct regressions using MG, AMG and CCEMG estimators, Table 7 displays the long run results. The basic model is estimated using CBI, exchange rate, trade openness and financial stability as independent variables. The results indicates that stronger CBI reduces inflation and it is significant at 5 percent. The use of CBI has a significant impact on the dynamic nature of inflationary changes, which is the preferred outcome and further supports the a priori expectations, as shown by the CBI's significantly negative effects in the inflation regression model in two out of the three estimators. The outcome is in line with the theoretical postulations which suggest that improvement in CBI leads to a lower level of inflation, thereby stimulating price effect on consumer spending.

Table 7: Panel estimation

Variable	Mean Group	CCEMG	AMG
Lcbi (Cukieman)	-0.429	-1.365**	-0.333**
	(-0.355)	(-0.678)	(-0.61)
lrgdp	-0.064***	-0.046*	-0.046*
	(-0.022)	(-0.041)	(-0.047)
lexch	-0.273	-1.946*	-0.688*
	-0.662	-1.163	-0.813
lgap	9.412	-0.121**	-0.297**
	13.78	0.073	0.884
lopn	-0.058	-0.130**	-0.078*
	(-0.047)	(-0.060)	(-0.056)
sta	0.182	0.428	0.069
	(-0.13)	(-0.368)	(-0.206)
trend	-0.024	-0.004	7.300
	(-0.022)	(-0.030)	(-0.024)
Constant	5.135	8.327	5.444
	(-3.184)	(-5.825)	(-3.719)
Observations	271	271	271
Number of Cross section	14	14	14

Note: CBI = Cukierman central bank independence Index. Standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Our results are consistent with the finding of Brumm (2011) and Posso and Tawadros (2013). Similarly, the impact of other variables suggests that, real GDP, exchange rate, and trade openness are significant at least in 2 of the estimates. However, financial stability is statistically not significant because the money and capital markets in Africa were not fully integrated into global markets (Batuo, *et al.,* 2018). These imply that, improvement in the level of real GDP, exchange rate, output gap and trade openness may reduce the level of inflation in these countries. Furthermore, the results are consistent with those of Barnichon & Peiris (2008).

4.4 Robustness check

To check the model for sensitivity to alternative measure of CBI we replaced the Cuckierman index with the Garriga index and re-estimate the model. The results are presented in Table 8.

Table 8: Robustness Check

Variable	Mean Group	CCEMG	AMG
lcbi_(garriga)	-1.279	-2.652**	-1.298**
	(-1.016)	(-1.628)	(-1.093)
lrgdp	-0.0571***	-0.068***	-0.047***
	(-0.019)	(-0.016)	(-0.013)
lexch	-1.007	-1.896**	-1.324*
	(-0.731)	(-0.853)	(-0.807)
lgap	6.267	-0.221**	-0.193***
	13.93	2.113	1.057
lopn	-0.020	-0.083*	-0.049**
	(-0.041)	(-0.045)	(-0.020)
sta	0.319**	-0.0461	0.145
	(-0.162)	(-0.256)	(-0.095)
trend	-0.040**	-0.026	0.0133
	(-0.017)	(-0.021)	(-0.014)
Constant	8.535**	11.77***	5.905
	(-3.688)	(-4.049)	(-4.694)
Observations	271	271	271
Number of cross-section	14	14	14

Note: CBI =Garriga (CBI) index Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

The results are consistent with the Cuckierman index. Specifically, real GDP, exchange rate, trade openness, and the Garriga index have negative influence on inflation, while, financial stability is significant only in the MG estimation. CCEMG, MG, and AMG results are comparable in terms of unbiasness, efficiency and reliability since they have common long run slope. From a policy viewpoint, the choice between AMG and CCEMG remains critical. Thus, the study considered CCEMG and AMG as the two main models to measure the impact of CBI on inflation or otherwise. The recommended augmented Phillips model may be utilized for policy decision-making since the parameters in this equation seem to follow a steady pattern for all estimates, preventing large distortions in the level of unemployment as a result

of policy changes.

5. Conclusion and Policy Recommendation

The study examined the relationship between CBI, financial stability and inflation among selected African countries. Previous studies showed mixed results. In this regard, this study is one of the few that employs Cukierman and Garriga CBI indexes for the baseline and robustness analysis, respectively using second-generation estimation techniques due to the presence of cross sectional dependence among the countries.

The study adopted the MG, CCEMG and AMG estimation techniques. The results revealed a significant and negative relationship between CBI and inflation, thus supporting the findings from extant literature.

It is important to note that greater CBI from government interference play a significant role in achieving lower inflation in Africa. Government interference in the affairs of central bank remained one of the greatest challenges faced by the institutions within the region; it is recommended that government should restrict their level of participation in terms of control over the central bank. To further mitigate this problem, greater independence need to be given to central banks and this will help in seeing a more effective central bank which will contribute significantly towards achieving lower inflation.

Future studies should focus on other developing and emerging regions of the world like the South East Asian (SEA), BRICS countries, Middle East and North Africa (MENA) region, while other variables such as rule of law, country political rights and civil liberties score could be explored based on the available gap in the literature. It is equally recommended that other estimation techniques like the generalized method of moment (GMM), least square dummy variable (LSDV), and least square dummy variable corrected (LSDVC) be employed in future studies.

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Appendix

Table 11: Panel Unit root tests

	Inflation	CBI	Real_GDP	Real_exchr	Outputgap	Openness	F_Stability
Null Hypothesis: common process estimates							
Levin, Lin &Chu t*	-7.118*[a]	-21.14*[b]	-10.770*[a]	-3.744*[a]	-10.035*[a]	-25.661*[a]	-6.769*[a]
Breitung t-stat.	-1.994**[a]	-9.041*[b]	-5.439*[a]	-2.174**[b]	-4.506*[a]	-2.411*[a]	-3.970*[a]
Harris-Tzavalis rho	0.806*[a]	-0.041*[b]	0.117*[a]	0.727*[a]	-0.063*[a]	-0.033*[a]	0.517*[a]
Null Hypothesis: individual process estimates							
Im, Pesaran & Shin Wstat	-6.127*[a]	-16.171*[b]	-11.140*[a]	-2.134**[a]	-13.283*[a]	-17.228*[a]	
ADF Fisher Chi-square	8.620*[a]	15.592*[b]	13.505*[a]	4.096*[a]	26.079*[a]	37.389*[a]	12.878*[a]
ADF Pperron Chi-Square	11.369*[a]	39.181*[b]	30.246*[a]	15.162*[a]	39.575*[a]	49.546*[a]	16.641*[a]
Null hypothesis: common process with no unit root							
Hadri Z-stat.	7.481*[a]	12.845*[a]	8.606*[a]	8.007*[a]	4.259*[b]	3.831*[b]	1.952**[a]
No. of Cross-sections	14	14	14	14	14	14	14
No. of Periods	35	35	35	35	35	35	35
Total observations	462	462	462	462	462	462	462

Note: a represent stationary variables at I(0), and b represents variables stationarity at I(1) ; while statistical significance is represented as *, **, *** for 1%, 5% and 10% respectively.