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The inflationary effect of the budget deficit: does financial sector development matter?

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Abstract

This study aims to examine the budget deficit–inflation relationship, considering financial sector development and broad money supply as moderating and mediating variables. For this purpose, a panel data set ranging from polled mean group, mean group, and dynamic fixed effect estimation techniques are employed. Hence, the pooled mean group estimation result reveals that the budget deficit is inflationary. In addition, GDP per capita, the effective exchange rate, financial sector development, regulatory quality, and the interaction term of the budget deficit and financial sector development are significant determinants of inflation. The study further examines the role of the broad money supply as a mediating variable in the budget deficit–inflation relationship. The structural equation model results and the mediation effect tests confirmed a partial mediation effect of the broad money supply on the budget deficit–inflation relationship. Based on the findings, it is recommended to strengthen regulatory quality, reduce broad money supply, and improve financial sector development. By doing so, we can create a more stable and efficient economy that benefits everyone in the long run.

Keywords: Inflation, Budget deficit, Mediational analysis

Introduction

It is an entrenched fact that the budget deficit has a prevalent effect on economic measures. For instance, the inflationary effect of a budget deficit is one among many. Macroeconomics theory postulates that budget deficits and inflation have well-established relationships. Sargent and Wallace (1981) explicitly argued that fiscally dominant governments, especially those with a budget deficit, opt for monetary financing (seigniorage). Therefore, the expansion of the money supply links the budget deficit and inflation. In the same vein, Boariu and Bilan (2007) also explain that a budget deficit financed by debt has an inflationary effect.

In a broader sense, the theoretical perspectives of the budget deficit–inflation nexus are labeled as monetarists and fiscal theorists. First, the quantity theory of money explains that inflation is always and everywhere a monetary phenomenon (Friedman, 1969). Thus, financing the budget deficit through money creation or seigniorage has a one-to-one effect on the price level (inflation). Second, the fiscal theory of price level advocates (Bassetto, 2008; Carlstrom & Fuerst, 2000; Gordon & Leeper, 2002) challenged

the conventional monetary theorists and explained the budget deficit–inflation relationship in two forms. The weak form of the fiscal theory of price level is based on monetarist arithmetic. The effect of the budget deficit on the price level depends on the monetary and fiscal authorities' coordination. Alternatively, the strong form of the fiscal theory of price level explains that the price level is determined by government debt and fiscal policy activities (taxes and spending plans). On the one hand, a budget deficit stemmed from a tax cut initially makes individuals feel wealthier and enhances aggregate demand and the price level, contrary to what the Ricardian equivalence theory explains. On the other hand, a tax increase to finance the budget deficit increases the cost of production and the price of products.

However, empirical studies (Catao & Terrones, 2005; Narayan & Seema, 2006; Solomon & De Wet, 2004) partially deny the theoretical budget deficit–inflation relationships and argue that it works only for developing countries. Because, nowadays, developed countries have independent central banks with the sole objective of price stability (Ishaq & Mohsin, 2015; Protopapadakis & Siegel, 1987). Empirical studies covering developed countries have also nullified the budget deficit and inflation theoretical relationship (see Blanchard and Fischer, 1989; Click, 1998; King & Plosser, 1985). Additionally, some others found an insignificant relationship between the budget deficit and inflation (see Brown and Yousefi, 1996; Dwyer, 1982; Hondroyiannis and Papapetrou, 1994; Rehman et al., 2008); whereas, empirical studies (see Aghevli & Khan, 1978; Darrat, 2000; Ekanayake, 2012; Metin, 1998; Nguyen, 2015) focused on developing countries found the detrimental effect of budget deficits on inflation, as forwarded by Sargent and Wallace (1981). This is because low-income countries have large public sectors, limited access to external debt, less tax effort, and less developed financial sectors. That means low-income countries rely on money creation or seigniorage income to finance budget deficits. Though much has been researched and written regarding the inflationary effect of a budget deficit, studies have provided contradictory and inconclusive findings. As a result, the debate over their relationship still lingers and remains confrontational.

This paper, therefore, is a new attempt to investigate the budget deficit–inflation nexus compared to past studies for the following reasons. First, the budget deficit–inflation nexus is investigated with a moderator variable, financial sector development. Evaluating their nexus with the moderating variable (financial sector development) is particularly significant because financial sector development plays a crucial role in stabilizing the price level in any economy (Ishaq & Mohsin, 2015). Second, apart from the data differences, the study incorporated new variables for investigation. Third, this study is carried out considering the dynamic panel econometric model estimation concerns (cross-sectional dependence, homogeneity, and endogeneity). Fourth, this paper uses multiple estimation methods and helps to check the robustness of the results. This paper, therefore, studies the long-run effect of the budget deficit on inflation, considering broad money (money supply) as a mediating variable and financial sector development as a moderating variable. The paper is organized as follows: the second section discusses empirical studies on the relationship between budget deficit and inflation. In doing so, the effect of moderating variable (financial sector development), mediating variable (money supply), and controlled variables are reviewed. The third section deals with the theoretical derivation of the model and the econometric model used to address the research questions

listed above; whereas the fourth section discusses the empirical results of the model in detail and the fifth section provides concluding remarks.

Related empirical review

Inflation is a buzzword having heating and cooling effects in every economy (Kelikume and Evans, 2015; Nas and Perry, 2018; Vinayagathasan, 2013). The negative effects of inflation are: uncertainties over future prices, lower savings and investment, inefficiencies, and distorted markets. Moreover, inflation makes economic actors myopic and dependent on short-term plans and forces investors to mobilize resources toward stable economies. Additionally, the cooling effects of inflation are reducing unemployment, decreasing the real burden of private and public debt, and keeping nominal interest rates above zero so that central banks can regulate interest rates to stabilize the economy. Recently, threshold analysis has dominated the inflation literature. They believe that if inflation surpasses a certain threshold level, it will have detrimental effects (see Eggoh and Khan, 2014; Fei et al., 2019; Kelikume, 2018; Kremer et al., 2013; Ndoricimpa, 2017). For example, high inflation can produce undesirable redistribution and welfare effects (Eggoh and Khan, 2014) and, contrary to Friedman (1969), negative inflation is irrelevant because a certain degree of inflation is necessary to promote the economy (Ahortor et al., 2011; Seleteng et al., 2013). Moreover, Temple (2000) and Kelikume (2018) affirmed that moderate inflation slows economic growth.

Sticking to African economies, Franses and Janssens (2018) explain that there is no such thing as "African inflation" that matters more. Because managing inflation pressure is one of the challenges that African policymakers encountered, and ultimately happened due to the fact that central banks in Africa have multiple objectives (growth and development, employment opportunity, and price stability). Money supply and financial sector development played an important role as mediating and moderating variables in the budget deficit–inflation nexus. Therefore, the budget deficit–inflation nexus is scrutinized, encompassing the direct effects of the budget deficit on inflation, the moderating effect of financial sector development, and the indirect effects through the mediating variables of money supply and exchange rate. Several empirical studies (Bleaney et al., 2016; Catao and Terrones, 2005; Ekanayake, 2012; Fakher, 2016; Kilindo, 1997; Metin, 1998) focused on developing countries have been conducted to investigate the effect of the budget deficit on inflation and confirmed that the budget deficit is inflationary. In particular, the direct effect of the budget deficit on inflation has been investigated by Bleaney et al. (2016), Catao and Terrones (2005), Metin (1998), and the results are corroborated as the budget deficit significantly affects inflation. On the contrary, some empirical studies deny the budget deficit–inflation nexus to advanced countries (see Bassetto & Butters, 2010; King & Plosser, 1985; Raravikar, 2003). Similarly, Bordo & Levy (2021) stated that the budget deficit–inflation nexus only holds during war times. While Ezeabasili et al. (2012), Kilindo (1997), and Nguyen (2015) articulate the relationship between the budget deficit and inflation or price level, they consider money supply as a mediating variable. Empirical evidence suggests that an increase in the money supply is associated with an increase in the price level (inflation). Accordingly, Kilindo (1997) recommended that money supply growth should be equivalent to real output growth, unless it is necessary to control fiscal financing from financial institutions. Conversely, such a relationship between the budget deficit and money supply is

rejected in some studies (see Barnhart & Darrat, 1988; King & Plosser, 1985). Furthermore, Fakher (2016), Loungani and Swagel (2001), and Ssebulime and Edward (2019) explored the inflationary effects of the budget deficit and exchange rate. They concluded that both the budget deficit and exchange rate have inflationary pressure. Lastly, this paper considers financial sector development as a moderating variable in explaining the budget deficit–inflation nexus, though empirical studies stress more on the effect of inflation on financial sector development (see Bittencourt, 2011; Sanusi et al., 2017). So far, there is no empirical work that examines the inflationary effect of budget deficits in relation to financial sector development. However, Haslag and Koo (1999), Krause and Rioja (2006), and Kim and Lin (2010) explain the essence of financial sector development in alleviating inflation pressures. Explicitly, financial sector development contributes to price level stability via enhancing the effectiveness of monetary policy. Similarly, Agoba et al. (2017) explain that financial sector development enables central banks to better target inflation by operating at a low cost and passing on lower interest rates to customers. Additionally, Ishaq and Mohsin (2015) explain that the fragile financial sector allows the government to finance the deficit through money creation.

Analytical framework

Various methods have been used to test the mathematical model derived, Eq. (1), but many of them rely on the ARDL model. For instance, ARDL, VAR, VECM, 2SLS, and GMM are the forerunner models. The current study made use of the ARDL model for a variety of reasons. First, the static panel data models (fixed effect, random effect, and polled regression model) based on OLS, LSDV, and GLS estimators are inconsistent when the lag of the dependent variable is incorporated as a covariate on the RHS of the model. Second, the ARDL model provides consistent estimates of both short-run and long-run and valid t-tests.

Perhaps most importantly, the ARDL model is suitable when variables are a mix of I (0) and I (1) and helps to mitigate the endogeneity problem that arises from the omission of significant variables. Third, when there is a contemporaneous correlation between error terms, the dynamic panel model based on the GMM estimator produces inconsistent estimates (Pesaran, 2006; Pesaran & Smith, 1995). Fourth, the ARDL model allows you to use estimation techniques like mean group (MG), pooled mean group (PMG), and dynamic fixed effect (DFE) estimators. However, in this paper, the ARDL model has estimated through PMG estimator because of the following reasons: first, the PMG estimator provides both short-run and long-run estimates with a single code, and second, it allows short-term parameters to be heterogeneous across countries, while long-term coefficients are supposed to be homogeneous across countries. But, the Hausman (1968) slope homogeneity test statistic is the selection mechanism among the three estimators. Therefore, the dynamic panel ARDL (p, q) model that relates inflation with a budget deficit and other explanatory variables is constructed as follows:

$$y_{i,t} = \sum_{j=1}^{p} \alpha_i y_{i,t-j} + \sum_{j=0}^{q} \beta'_i x_{i,t-j} + \eta_i + \varepsilon_{it}, \tag{1}$$

where $y_{i,t}$ denotes the dependent variable (inflation), $(x\prime_{it})$ denotes a vector of explanatory variables: containing the main interest variable budget deficit, mediating and moderating variables such as broad money and financial sector development, and other explanatory variables, ηi denotes unobserved time-invariant heterogeneity, and ε_{it} is idiosyncratic error term. With parameterization and explicitly incorporating the main interest variable, budget deficit, Eq. (1) is transformed to the error correction model (ECM) that takes a form:

$$\begin{aligned}\Delta y_{i,t} = \varnothing_i\left(\beta_i y_{i,t-j} - \beta_i BD_{i,t-j} - \beta\prime_i x_{i,t-j}\right) + \sum_{i=1}^{p-1}\vartheta_i \Delta y_{i,t-1} \\ + \sum_{i=1}^{q-1}\vartheta_i \Delta BD_{i,t-1} + \sum_{i=1}^{q-1}\vartheta\prime_i \Delta x_{i,t-1} + \eta_i + u_{i,t},\end{aligned} \tag{2}$$

where $\varnothing_i$ denotes the speed of adjustment, β^s denote long-run coefficients, and $\vartheta^s{}_i$ are short-run coefficients; whereas i and t represent cross-section units and time, respectively. Finally, the interaction variable is also incorporated into the main model to examine the moderating role of financial sector development on the budget deficit–inflation nexus. The moderation effect exists when the moderating variable (financial sector development) significantly affects the magnitude and or sign of the budget deficit–inflation nexus. That means the interaction (combined) effect of the budget deficit and financial sector development is statistically significant. Furthermore, to check the mediating role of money supply on the budget deficit–inflation nexus, the structural equation model (SEM) Eq. (2) is estimated. To say the mediation effect exists, the budget deficit–inflation relationship should be explained through the mediator (broad money supply) variable. Figure 1 below visualizes the relationship of variables in a more precise way for non-meditating and mediating models.

Specifically, Baron and Kenny's (1986) and Zhao et al. (2010) approaches are used in conducting the mediation analysis. Baron and Kenny's approach follows the following steps for mediation to exist: first, if both or one of the budget deficit-broad money supply and broad money supply-inflation level slope parameters are not significant, there is no mediation. Second, when both the budget deficit-broad money supply and broad money supply-inflation level slope parameters are significant, there is "some" mediation.

A) If Sobel's z-test is significant and the budget deficit- > inflation level slope parameter insignificant, complete mediation exists. B) If both Sobel's z-test and the budget deficit- > inflation level slope parameter are significant, partial mediation exists. C) If Sobel's z-test is insignificant and the budget deficit- > inflation level slope parameter

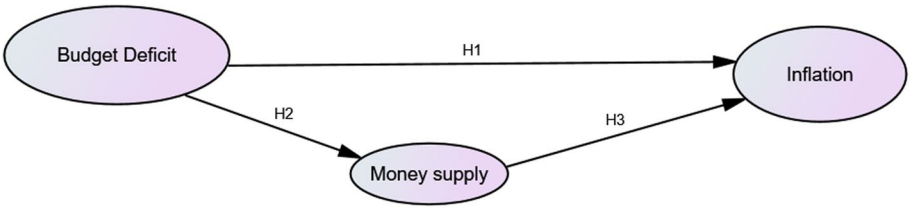

Fig. 1 Mediational effect of money supply on the inflationary impact of the budget deficit

is significant, partial mediation exists. D) If neither Sobel's z-test nor the budget deficit- > inflation level slope parameter is significant, partial mediation exists; whereas Zhao, Lynch & Chen's approach follows the following steps mediation to exist:

I. If neither the Monte Carlo z-test nor the budget deficit–inflation slope parameters is significant, then there is no mediation. II. If the Monte Carlo z-test is insignificant and the budget deficit–inflation slope parameter is significant, then there is no mediation. III. If the Monte Carlo z-test is significant and the budget deficit–inflation slope parameter is insignificant, full-mediation exists. IV. If the Monte Carlo z-test and the budget deficit–inflation slope parameters are significant and point in the same direction, partial mediation exists. V. If the Monte Carlo z-test and budget deficit–inflation slope parameters are significant and point in the opposite direction, partial mediation exists.

Data and variables

This study covers 29 African countries and the period ranges from 1988 to 2018. The variables involved in the study are as follows: inflation is the dependent variable measured in the consumer price index (%), and the data retrieved from the IMF financial data set. The main interest variable of the study is whether it exists when the government expends more than it collects in terms of taxation, and the data are retrieved from the World Bank database. Broad money: M2 is used as a proxy for broad money supply and the data are retrieved from the World Bank database. This variable is considered as a mediating variable in explaining the inflation–budget deficit relationships. There are numerous proxies for financial sector development, but in this paper used bank deposit (% of GDP) for consistency with theoretical arguments. Finally, this paper introduces the interaction variable to examine the moderation effect of financial development on the budget deficit–inflation relationship, and control variables that are expected to have a significant effect on inflation are presented in Table 1 with their mnemonic, measurement, and source of data.

Empirical results

Table 6 presents the indirect effect coefficient with Z-value, *p*-value, and RIT&RID statistics. Accordingly, in both the Sobel and Monte Carlo tests, the Z-value is significant at a 1% level of significance. Thus, the mediation (partial) effect of the SEM model is supported by both approaches. Perhaps most importantly, the ratio of the indirect

Table 1 Variables involved in the study

Variables	Mnemonic	Measurement	Source
Inflation	Loginf	(%) CPI	IMF financial statistics
Budget deficit	Budget	% of GDP	WB, development indicator
Broad money	M2	% of GDP	WB, development indicator
Financial development	FD	% of GDP	WB, development indicator
Interaction effect	Budget_FD	% of GDP	Authors calculation using WB data
Effective exchange rate	EER	(%) percentage	WB, development indicator
GDP per capita	Gdppercapita	In dollars ($)	WB, development indicator
Regulatory quality	RegQ	Index [− 2.5, 2.5]	WB, governance indicator

effect to the total effect (RIT) and the ratio of the indirect effect to the direct effect (RID) results are interpreted as follows. The RIT of a budget deficit is determined as (0.006/0.030) = 0.214, meaning that about 21% of the variation of the dependent variable inflation is due to the mediation effect of the broad money supply. Furthermore, the RID result shows that the indirect effect of the budget deficit on inflation level is 0.2 times (0.006/0.036) as large. Finally, the mediation analysis findings are consistent with those of Koyuncu (2014) and Ahin (2019). The mediating analysis was carried out by Koyuncu (2014) and Ahin (2019) using vector autoregressive (VAR) and ARDL models, but in this study, a structural equation model and the post-estimation STATA code "medsem" were used.

Descriptive statistics

As part of the preliminary analysis, Table 2 displays descriptive statistics for each of the variables involved in the study. The table above depicts that the mean value of the budget balance is negative. That means, on average, African countries are under budget deficit arenas within the study period. More explicitly, it accounts for − 3.55% of mean value, 53.3% of minimum value, and 40.34% of maximum value. In the same vein, summary statistics of inflation are substantially higher, and to deal with outlier effects, the natural logarithm of inflation is used. Within the study period, 2.02% mean value, − 3.207% minimum value, and 10.07% maximum value are recorded. In addition, broad money and financial sector development take 27.6% and 18% of GDP, respectively. The proxy for the level of development, GDP per capita of African countries, mean value is around $2485, the governance indicator (regulatory quality) accounts for a mean value of-0.68%, and the moderating variable (Budget_FD) accounts for a mean value of-70.4%. Lastly, Fig. 2 in the appendix displays the trend of inflation for African countries covering the period ranging from 1988 to 2018. From the figure, it can be observed that there are notable peaks and troughs. These fluctuations are a result of economic downturns or improvements in the economy, reflecting periods of higher and lower inflation rates over the years.

Unit-root test

Before the econometrics analysis, to ascertain the order of integration of the variables involved in the model, two unit-root tests are employed. Specifically, the Levin–Lin–Chu

Table 2 Descriptive statistics

Variable	Obs	Mean	Std. Dev	Min	Max
Loginf	837	2.029	1.365	− 3.207	10.076
Budget	837	− 3.55	4.746	− 53	40.34
M2	837	27.631	20.166	2.857	119.383
FD	837	18.093	15.983	0.781	88.85
Budget_FD	837	− 70.407	159.14	− 3098.868	472.661
EER	837	113.925	45.412	− 4.762	538.405
Gdppercapita	837	2485.518	2266.886	406.663	11,869.53
RegQ	837	− 0.684	0.438	− 2.298	0.339

Source: Authors estimation result (2021)

Table 3 Unit-root test

Variables	Levin–Lin–Chu unit-root test	Im–Pesaran–Shin unit-root test
Loginf	− 0.1978	− 17.2976***
Budget	− 8.6685***	− 16.7112***
M2	− 14.7705***	− 14.5434***
FD	− 17.1446***	− 14.2873***
Budget_FD	− 12.2565***	− 15.4338***
EER	− 9.2042***	− 14.2481***
GDP per capita	− 12.7040***	− 18.4042***
RegQ	− 8.6024***	− 12.6159 ***
D.loginf	− 22.5175***	− 17.9288***

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Source: Authors estimation result (2021)

unit-root test and Im–Pesaran–Shin unit-root tests are performed. In both tests, the null hypothesis entails that variables are non-stationary, and the alternative is that the variables are stationary.

According to Table 3, all the variables are stationary at I (0), except the dependent variable inflation, which is stationary at the first difference, I (1). As a rule of thumb, for robust ARDL estimates, I (0) and I (1) stationary variables are required, not I (2).

Pooled mean group estimates

Table 4 presents long-run estimates of the pooled mean group estimator, mean group estimator, and dynamic fixed effect estimator in columns (2), (3), and (4), respectively. In addition to long-run estimates, the last two rows presented the error correction term and the Hausman (1968) slope homogeneity test statistic.

The speed of adjustment (ϕi) is negative and significant as expected, a necessary condition for the existence of long-run relationships between the variables. Otherwise, the insignificant coefficient of ϕi implies the absence of long-run equilibrium. According to the h-statistic, the Hausman (1968) slope homogeneity test does not reject the null hypothesis that entails long-run estimates are homogeneous, and hence the model supports the PMG estimator. Thus, following the Hausman (1968) slope homogeneity test statistic, the pooled mean group estimator results of the log-linear ARDL model are accepted as the main results. But for comparison purposes, the mean group (MG) and dynamic fixed effect (DFE) estimators are considered.

Consequently, the result of the model shows that budget balance is negatively related to inflation in all three methods. In other words, the budget deficit is inflationary. Econometrically speaking, a 1% increase in the budget deficit is associated with a 5.1% increase in the inflation rate, ceteris paribus. In comparison, the coefficients of the budget deficit are nearly the same for PMG and MG estimators, while the DFE coefficient is a bit lower. Relating to past studies conducted by Metin (1998), Catao and Terrones (2005), Lin and Chu (2012), and Bleaney et al. (2016), the sign of the coefficients are the same,

Table 4 Long-run estimates

Dependent variable: inflation (loginf)			
Variables	**(PMG)**	**(MG)**	**(DFE)**
	ECM	**ECM**	**ECM**
Budget	− 0.0515***	− 0.0778***	− 0.0290
	(0.0178)	(0.0278)	(0.0183)
M2	0.0251**	0.00542	0.00373
	(0.0104)	(0.0146)	(0.00981)
FD	− 0.0720***	− 0.0629***	− 0.0474***
	(0.0139)	(0.0144)	(0.0135)
Budget_FD	0.00116**	0.00212	0.000378
	(0.000583)	(0.00132)	(0.000598)
EER	0.00997***	0.00977***	0.00696***
	(0.00106)	(0.00175)	(0.00136)
Gdppercapita	0.000415***	0.000571***	0.000387***
	(4.60e-05)	(0.000102)	(4.81e-05)
RegQ	− 0.313***	− 0.508***	− 0.359***
	(0.109)	(0.133)	(0.126)
EC coefficient (φ)	− 0.78391277***	− 1.0101844***	− 1.0037232***
h-statistic	3.487	P-value	0.837
Observations	806	806	806

Standard errors in parentheses

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Source: Authors estimation result (2021)

PMG denotes pooled mean group estimator, MG denotes mean group estimator, DFE denotes dynamic fixed effect estimator, and h-statistic is Hausman (1968) slope homogeneity test

but the magnitude in our study is a bit higher compared to them. In addition, in all three methods, financial sector development and regulatory quality are statistically significant and negatively related to inflation. In other words, if the government works to stabilize the economy through regulations and policies, or if there are positive changes in the development of the financial sector, the inflation rate will fall. These findings are consistent with past studies by Agoba et al. (2017) and Papademos (2006), which also support the positive effects of financial development and government regulatory policies. Furthermore, broad money, GDP per capita, and exchange rate devaluation are inflation-enhancing factors. Again, these findings are consistent with mainstream macroeconomic economic theory and the empirical findings of Canetti and Greene (1991), Payne (2002), and Imimole and Enoma (2011).

Furthermore, the moderation variable Budget_FD is statistically significant at a 5% level of significance, indicating that the budget deficit is not inflationary when the financial sector of the economy is not fragile. This finding is informative, theoretically consistent, and in line with the empirical findings of Peiris and Clément (2008) and Ishaq and Mohsin (2015). Finally, the signs of the estimated coefficients are consistent with different estimators; they do not vary from the PMG estimator to the MG and DFE estimators, but some of the variables are insignificant for the MG and DFE estimates.

Mediating effect of money supply

The mediation analysis employs Baron and Kenny's (1986) and Zhao et al. (2010) approaches. A mediator variable is a variable that explains the relationship between a predictor variable and the outcome variable. In this paper, the broad money supply is the mediating (intervening) variable to explain inflation–budget deficit relationships. For this purpose, the structural equation model (SEM) is estimated and followed by the Sorbet and Monte Carlo mediation effect significance tests. The Baron and Kenny (1986) mediation analysis approach, later modified by Iacobucci et al. (2007) and Zhao et al. (2010), proposed a series of interrelated steps for conducting mediation analysis via structural equation model.

The first step is to evaluate if the predictor variable budget deficit significantly affects the outcome variable inflation level. The second step is to evaluate if the predictor variable budget deficit significantly affects the mediating variable broad money supply. And the final step is evaluating the effect of the predictor variable, the budget deficit, and the mediating variable, broad money supply, on the outcome variable, inflation. In a nutshell, it assesses whether or not there are significant relationships between the budget deficit and the broad money supply, or between the broad money supply and the level of inflation. The structural equation model results presented in Table 5 above show that in all the models (columns 2, 3 & 4), broad money supply and budget deficit are statistically significant at a 1% level of significance. This result confirmed the existence of the mediation effect; thus, when the mediating effect of the money supply is controlled, the effect of the budget deficit is reduced. In addition to the SEM estimation results, the study also sought to identify the direct and indirect effects of the interest variable and budget deficit. For this purpose, the indirect effect significance tests of the Sobel and Monte Carlo tests are presented, including the RIT and RID statistics as shown in Table 6.

Table 6 presents the indirect effect coefficient with Z-value, *p*-value, and RIT&RID statistics. Accordingly, in both the Sobel and Monte Carlo tests, the Z-value is significant at a 1% level of significance. Thus, the mediation (partial) effect of the SEM model is supported by both approaches. Perhaps most importantly, the ratio of the indirect effect to the total effect (RIT) and the ratio of the indirect effect to the direct effect (RID) results are interpreted as follows. The RIT of a budget deficit is determined as

Table 5 Structural equation model

Variables	(1) Loginf	(2) M2	(3) loginf
M2			− 0.0149***
			(0.00228)
Budget	− 0.0295***	− 0.424***	− 0.0358***
	(0.00989)	(0.146)	(0.00970)
Constant	1.924***	26.12***	2.312***
	(0.0586)	(0.866)	(0.0826)
Observations	837	837	837

Standard errors in parentheses

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Source: Authors estimation result (2021)

Table 6 Significance testing of indirect effect

Estimates	Delta	Sobel approach	Monte Carlo approach
Indirect effect	0.006	0.006	0.006
Std. Err.	(0.002)	(0.002)	(0.002)
z-value	2.652	2.652	2.677
p-value	0.008***	0.008***	0.007***
RIT	(0.006/0.030) = 0.214		
RID	(0.006/0.036) = 0.176		

Standard errors in parentheses, and ***p < 0.01, **p<0.05, *p<0.1

Source: Authors estimation result (2021)

RIT denotes ratio of the indirect effect to the total effect, and RID is the ratio of the indirect effect to the direct effect

(0.006/0.030) = 0.214, meaning that about 21% of the variation of the dependent variable inflation is due to the mediation effect of the broad money supply. Furthermore, the RID result shows that the indirect effect of the budget deficit on inflation level is 0.2 times (0.006/0.036) as large. Finally, the mediation analysis findings are consistent with those of Koyuncu (2014) and Ahin (2019). The mediating analysis was carried out by Koyuncu (2014) and Ahin (2019) using vector autoregressive (VAR) and ARDL models, but in this study, a structural equation model and the post-estimation STATA code "medsem" are used.

Robustness check

As a means of checking the robustness of the pooled mean group estimator results, the data are submitted to the general moment's method (GMM), augmented mean group (AMG), and dynamic ordinary least square (DOLS) estimation methods. Results presented in Table 6 indicate that findings are consistent in terms of the sign, magnitude, and level of significance with the pooled mean group estimator results displayed in Table 4. That means the sizes of the coefficients are almost the same, and the signs of the coefficients are as expected and statistically significant for different estimators. The only difference captured in the AMG results is that the broad money supply is insignificant; however, the sign of the coefficient is still the same.

Moreover, Table 7, column (3 and 4), presents the GMM and DOLS estimation results. Except for the coefficients of financial sector development and the interaction term, which are insignificant in the GMM method, the findings are consistent with the pooled mean group estimator results. But the sign of the coefficients is still the same. To sum up, in all the AMG, GMM, and DOLS methods, substantial differences are not found to call into question the pooled mean group estimator results presented in Table 4.

Conclusion and recommendation

This paper examines the inflationary effect of the budget deficit for African countries using panel data ranging from 1988 to 2018. In doing so, the study demonstrates the importance of financial sector development and broad money supply moderating and mediating effects in estimating autoregressive distributed lag (ARDL) and structural

Table 7 Robustness test

Dependent variable: inflation (loginf)			
Variables	**(AMG)**	**(GMM)**	**(DOLS)**
Budget	− 0.0718***	− 0.0235*	− 0.0722***
	(0.0245)	(0.0123)	(0.00886)
M2	0.00620	− 0.0138***	0.0227***
	(0.00896)	(0.00485)	(0.00541)
FD	− 0.0286*	− 0.00361	− 0.0436***
	(0.0149)	(0.00586)	(0.00762)
Budget_FD	0.00236***	0.000243	0.00279***
	(0.000877)	(0.000297)	(0.000313)
EER	0.00802***	0.0103***	0.00799***
	(0.00123)	(0.000321)	(0.000615)
Gdppercapita	0.000207***	0.000130***	0.000129***
	(3.13e-05)	(1.26e-05)	(1.73e-05)
RegQ	− 0.856***	− 0.633***	− 0.237***
	(0.0977)	(0.0578)	(0.0744)
L.loginf		0.0996***	
		(0.0271)	
Observations	837	806	713
Number of Year	31	31	31

Standard errors in parentheses

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Source: Authors estimation result (2021)

AMG denotes augmented mean group estimator, GMM denotes general method of moment, and DOLS is dynamic ordinary least square

equation (SEM) models. Long-run estimates of the ARDL model are obtained from a pooled mean group estimator. In addition, the results of the mean group estimator and the dynamic fixed effect estimator are used for comparison purposes.

The results of different estimators suggest that the budget deficit is inflationary. In particular, the results of the PMG estimator state that a 1 percent increase in the budget deficit is associated with a 5.1 percent increase in the inflation rate, ceteris paribus. In comparison, budget deficit coefficients are approximately the same for all PMG, MG, and DFE estimators. In addition, regulatory quality and financial sector development have significant negative effects on inflation. In other words, if the government works to stabilize the economy through regulations and policies, or if there are positive changes in the development of the financial sector, the inflation rate will fall. In contrast, broad money supply, GDP per capita, and exchange rate depreciation are inflationary factors. Apart from the comparison group estimators, AMG, DOLS, and GMM estimation methods are used to check the sensitivity of results, controlling cross-sectional dependence and endogeneity issues. Accordingly, in all the methods, the coefficients are approximately the same, and they indicate that results are robust to different estimators.

There is a typical portrayal that budget deficits are financed by money creation in developing countries, and thus, inflation increases. The inflationary effect is pronounced

when there is a fragile and weak financial sector. To verify such hypothetical relationships, both the mediation and moderation effect analyses are conducted by estimating the ARDL and SEM models and performing post-estimation Sobel and Monte Carlo mediation effect tests. Overall, the findings support the weak form of the fiscal theory of price level by confirming the moderation and mediation effects of financial sector development and broad money supply on the relationship between budget deficit and inflation rate.

Based on the paper's findings, the following recommendations are drawn. Improving regulatory quality: non-enforceable institutions are unlikely to provide incentives. If African countries are to correct price instability, they must adhere to the institutions established as well as the policies and regulations put in place. Reducing broad money supply: African governments need to reduce their budget deficits and maintain power, but the current method of using inflationary taxation to achieve this goal can be problematic. The increase in money supply often leads to higher prices and reduces the value of money. To counteract this, it is necessary to decrease the broad money supply. However, if governments use this approach for productive investment, it might have a positive impact on the economy. Finally, I would highly recommend focusing on financial sector development as it has been proven to be beneficial in a number of ways. For one, it enhances the effect of monetary policies, which is crucial for maintaining a stable economy. Additionally, it can increase productivity and contribute to the ease of central bank monetary policy rules and inflation targeting. Overall, investing in the financial sector is a smart move for any country looking to improve its economic performance.

Appendix

See Fig. 2.

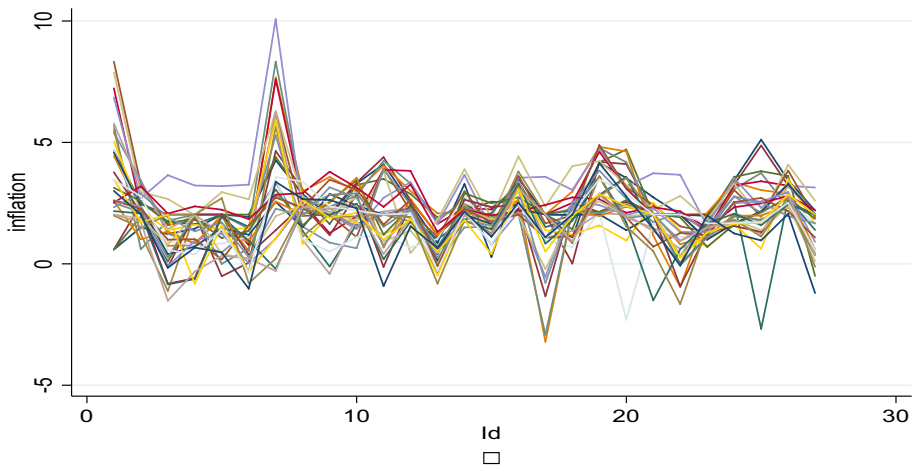

Fig. 2 Inflation trend

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Declarations

Ethics approval and consent to participate
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Consent for publication
The author personally approve that the paper should be published in your journal.

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The author declares that there is no competing interest.

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