Dynamics of Inflation and Financial Development: Empirical Evidence from Ghana

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Abstract

The study examines the dynamic link between inflation and financial development in Ghana using annual time series from 1964-2012. Specifically, the paper assessed whether the direction of causality between the two differs in the short and long run. In the short run, the paper established a dual negative relationship between the two, while a unidirectional negative effect of inflation on financial development was detected in the long run using sequence of econometric techniques. Inflationary effect was much stronger on Private Credit/GDP than on M2/GDP, while the dampening effect of financial development on inflation largely originated from Private Credit/GDP.

Keywords: Inflation, Financial Development, Deepening, Intermediation, Bivariate, Multivariate, Correlation Analysis, Engel-Granger Causality, Vector Error Correction, Vector Autoregression Models, Variance Decomposition, Impulse Response and Ghana.

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1. Introduction and Motivation

A consensus among economists suggests that financial markets and institutions are important factors in supporting economic development and reducing inequality[1]. Indeed, financial institutions arise to tackle endogenous frictions that are present in the process of allocating credit and investment capital by reducing informational asymmetries, transaction cost and at the same time as mitigating financial constraints of the poor (Khan, 2002)[2]. In facilitating diversification, financial institutions also improve welfare by essentially minimizing the effects of macroeconomic shocks (Kim, Lim and Suen, 2010). Consequently, it is very crucial to identify what causes of financial development. The extant literature also noted the repercussions of high and sustained inflation on both individuals and the overall economic performance, via its implications on the financial systems. In particular, Kim et al (2010) argued that higher inflation can repress financial intermediation by eroding the usefulness of money asset and by leading to policy decisions that distort the entire financial structure. In agreement, Choi, Smith and Boyd (1996) argued that high inflation tends to exacerbate a number of financial market frictions which interferes with the provision of investment capital as well as its allocation (also, see Ploeg and Alogoskoufis, 19943). Moreover, without these frictions, the Modigliani-Miller Theorem would obtain and the nature of finance would be irrelevant for allocations. In line with relevant of some level of inflation, English (1999) found positive effect of inflation on financial development as households tend to substitute purchased financial services for holding real money balances, boosting the provision of financial services.

Though the theoretical stances on the link between inflation and financial development are mixed, extant empirical works have provided ample support for the notion that inflation negatively affect financial development in the long run and hence, price stability must be a fundamental prerequisite for successful financial development (Boyd et al, 2001; Ghazouani, 2005; Keho 2009; Bittencourt, 2010; Kim, et al. 2010; Odhiambo, 2012). Consequently, inflation-finance link has taken a central stage in recent times for most monetary authorities including Ghana, given the pursuance of current inflation targeting as the primary monetary policy framework. Since the last 1990s, monetary policy in Ghana has vigorously pursued price stability, leading to the change in policy regime from monetary targeting to inflation targeting. In fact, the eminent opposite movements of inflation and broad money (to GDP ratio) especially in the early 2000 (see figure 1) coupled with debt overhang and macroeconomic instability, set the pace for inflation targeting regime in 2002.

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[1] Bagehot (1873) and Hicks (1969) argued that the industrial revolution could not suggest itself until banks and other financial institutions developed sufficiently to provide the necessary liquidity.

[2] Bencivenga and Smith (1991) argue that financial sector development can smooth the transfer of productive capacity across agents and time from less productive users to those with greater potential.

[3] In the absence of an intergenerational bequest motive, higher inflation tempts households to allocate a greater proportion of income to private consumption and to hold more real money balances. This means that a smaller share of income is committed to investment and savings, so that real per capita growth is reduced.
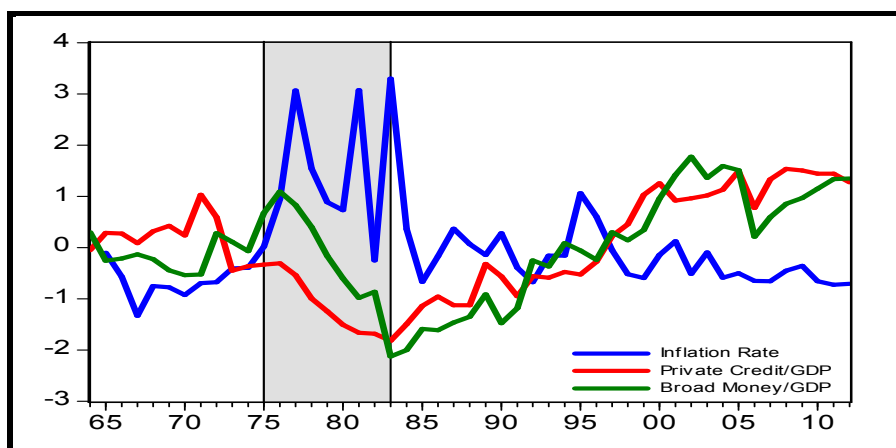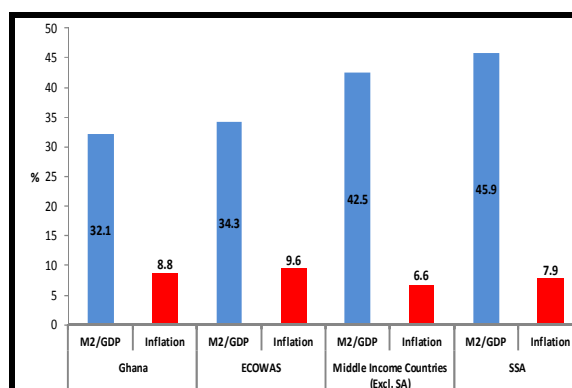
Figure 1: Normalized Trends in Inflation and Financial Development

Since the goal of price stability enshrined in inflation targeting framework required a crucial role of a developed financial system, a number of policy reforms were introduced by the Central Bank (for details, see Bawumia, 2010) to enhance the efficiency of the transmission of monetary policy. Financial Sector Strategic Plan (FINSSIP) was also launched in 2003 to continue the milestone achieved by Financial Sector Adjustment Programme, FINSAP (1983-2000), including the liberalization of the financial system, rural banking and the proliferation of non-bank financial institutions. Headline Inflation remarkably decelerated on back of these numerous reforms and policies, recording 32-months of single-digit inflation since mid-2010 to end the year 2012 at 8.8%.

In addition, the financial sector has remarkably transformed and deepened, thanks to these batteries of reforms. Currently, the financial system has expanded to comprise the Central Bank, 26 universal banks (excluding APEX bank which is a mini-central bank for rural banks), 138 rural and community banks, 52 non-Bank Financial Institutions and 3 Credit Reference Bureaus. Of the 26 universal banks, 15 are foreign-owned (with 6 Pan African) and remaining 11 banks are domestically owned, out of which only two (2) are government controlled banks. Although the entrants of foreign banks into the financial system have substantially enhanced competition among financial institutions in Ghana, overall financial sector is relatively under-developed. Domestic credit to private sector remained subdued due to entrenched fiscal dominance which exacerbates inflationary pressures and also tends to increase cost of borrowing to the private sector. In addition, the financial system is still overwhelmed with large unbanked informal sector (over 70% of the population) and poor information which hampers credit delivery. The economy remains highly cash base with its associated implication on exchange rate volatility and inflation.
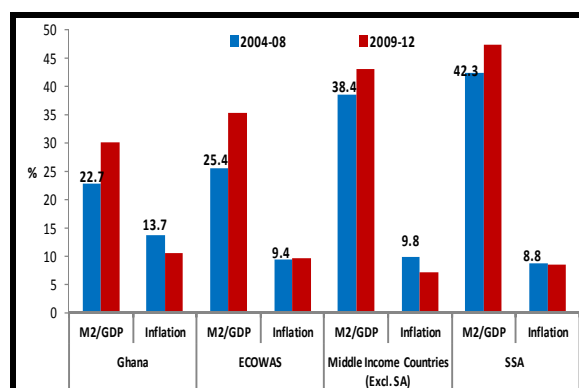
Figure 2: Regional Comparison of Inflation and Financial Deepening (2004-2012)
Figure 3: Regional Comparison of Inflation and Financial Deepening (2012)

In terms of regional comparison (see figures 2 and 3), there are still serious concerns as inflation rates in Ghana remain very high above the averages of both SSA and Middle Income Countries for the period 2004-2012 (but only lower than ECOWAS average in 2012). Financial deepening (M2/GDP), on the other hand, also remains below the respective regional averages since 2004. The relatively small and under-developed financial system

alongside lingering high and sustained inflationary episodes has rekindled research interest into the link between the two in order to aid policy decision.

However, the empirical evidence in the Ghanaian context remains inadequate and diverse. Some empirical studies in SSA which included Ghana (e.g. Boyd et al, 2000) found a negative link between the two. In fact, these studies largely over-relied on cross-sectional or panel analysis which tends to shroud the country-specific development. In addition, the main drawback of these studies is that inflation was treated as an exogenous variable which ignores a feedback effect of financial sector development on inflation.

A notable exception on the inflation-finance link in Ghana however is the study by Abbey (2012)[4] which used Bounds Testing approach to cointegration with quarterly data from 1990 to 2008. Using only inflation and financial sector indicators in the study, Abbey found no long run relationship between the two variables. In addition, he found conflicting results as the pair-wise correlation analysis established negative link between two, while the short run regression analysis indicated a positive link with unidirectional causality running from inflation to financial sector development. The inconclusive empirical results on Ghana therefore warranted this current study to carry out a thorough examination to establish the exact link between inflation and financial development.

This current paper differs as it is based on a framework that permits a two-way interaction between the variables while controlling for other factors that influence the link between the two. Thus, in this study, all variable including the measures of financial sector conditions, inflation and other conditioning information set selected to control for other theories of the finance-inflation relationship are endogenously treated in a Vector Autoregression (VAR) framework. The import of this approach is that it prevents potential simultaneity bias, while permitting feedback effects from the variables of interest. Particularly, the study prevents the possibility of omitted variable biases by including a measure of fiscal condition to control for the degree of government temptation to engage in financial repression; as well as a set of variables designed to control for economic development and other external factors by using real GDP per capita and openness to international market respectively. Thus, the study attempts to extent the literature by examining both the short and long run dynamic relationships between inflation and financial sector development in Ghana, by specifically

- examining the impact of inflation on depth of financial sector development and financial intermediary services, and also
- examining whether better functioning financial intermediaries exert a causal influence on inflation.

Unlike Abbey (2012), this study found negative short-run and long-run relationships between inflation and financial development in Ghana. In the short run, the paper established a dual negative relationship between the two variables, while a unidirectional effect of inflation on financial development was detected in the long run using sequence of econometric techniques. Inflationary effect was much stronger on Private Credit/GDP than on M2/GDP, while the dampening effect of financial development on inflation largely originated from Private Credit/GDP.

The remainder of the study is structured such that the next section provides a brief theoretical and empirical literature on the link between the two. Section three highlights the data and preliminary analysis. The section four concentrates on methodology and explanation of empirical results, while the final section provides the conclusion and policy recommendations.

2.   Literature Review

Indeed, the extant literature has mostly concentrated on inflation-growth and finance-growth nexus, which have lived separate lives. Several influential studies in the mid-1990s and early 2000 (including Bruno and Easterly, 1998; Haslag et al. 1999; and Rousseau et al, 2000; Andrés, Hernando and López-Salido, 2002) provided the empirical basis for the widely supported negative relationship between growth and inflation. Particularly, Bruno et al (1998) presented a comprehensive examination of the growth-inflation link that offers some clarification. They concluded that the negative long run relationship between inflation and growth occurs once inflation exceeds some critical level[5]. Notable studies in the finance-growth literature including McKinnon (1973), Shaw (1973), Roubini and Sala-i-Martin (1992), King and Levine (1993), Rousseau and Watchel (1995), Haslag and Koo (1999), Levine, Loyaza, and Beck (2000) also found strong positively correlation between the two. In particular, using a large cross section of 98 countries from 1960 to 1985, Roubini et al (1992)[6] identified that

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[4] In Abbey (2012), financial development was measured by four different indicators including ratio of domestic credit of commercial banks to GDP, private credit to GDP ratio, Value Traded in Ghana Stock Exchange to GDP ratio and market capitalization to GDP ratio, while inflation was computed as the log difference of consumer price index (CPI).

[5] Bruno et al (1998) found inflation as high as 40 percent per year to have significant negative impact on economic growth but a number of countries with sustained inflation of 20-30% suffered no major adverse consequences.

[6] Roubini et al (1992) indicated that financial repression inhibits growth as it clearly leads to inefficient allocation of capital, high cost of financial intermediation, and lower rates of return to savers. The empirical findings on the effect of removing financial repression (i.e. financial liberalization) on growth supports this view, but various channels through which liberalization spur growth have been evidenced.

countries that repress their financial sectors grow less swiftly than those countries that do not.

The missing component of the above two strands was however emphasized by Rousseau et al (2000). They argued that though inflation matters in many theoretical growth models because it alters the returns on money which can have real sector consequences, the channel by which inflation affects growth may run, at least in part, through the financial sector. Thus, the indirect channel for the negative effect of inflation on growth is through its impacts on financial sector development. Prior to Rousseau et al (2000), the literature had indeed established that high inflation causes financial repression. Independently, McKinnon (1973) and Shaw (1973)[7] were the first to spell out the notion of financial repression, defining it as the set of government legal restrictions preventing the financial intermediaries in the economy from functioning at their full capacity level. That is, financial repression implies the lack of depth of financial intermediation in the financial markets of the developing world. They outlined cases of financial repression as follows; first, the banking system is compelled to hold government bonds and money through the imposition of high reserve and liquidity ratio requirements because it permits the government to finance budget deficits at a low or zero cost; second, given that government revenue cannot be extracted easily from private securities, the development of private bond and equity markets is discouraged.

Regarding why high inflation is responsible for the low level of financial development, Altig (2003) theoretically indicated that high inflation rates result in low returns to capital and hence peter out the incentives to save and invest. Thus, high inflation tends to hamper long term financial contracting and hence induces financial intermediaries to maintain very liquid portfolios. However, if inflation rate is high but predictable, there is no reason why real returns should be different. A more standard argument however is the fact that higher inflation is tied with greater inflation volatility, and hence greater uncertainty. The problem is particularly heightened when collateral is required for the efficient functioning of borrowing and lending markets. With disincentive to save due to high inflation, too little saving inhibits the accumulation of collateral and thereby impedes growth-enhancing financial intermediation (See also Smith, 2003).

Empirically, studies examining the link between inflation and financial development are based on cross-sectional, panel and times series analysis. Both bank-based and market-based financial indicators are used to measure the extent of financial development. These frequent used indicators include domestic credit to private sector to GDP ratio, broad money to GDP ratio, commercial bank's asset/GDP ratio (for bank-based), as well as market capitalization/GDP ratio, valued traded of stock market/GDP ratio (for Market-based). Notwithstanding the indicator employed, empirical studies generally show a strong and significant negative link between the inflation and financial development, although the direction of causality is still not clear. Also a threshold level of inflation has been established on the link between the two, below which inflation affects financial development differently than above. The remaining paragraphs outline some of the findings of the empirical studies on inflation-finance nexus.

Boyd et al. (2000), Odhiambo (2012) and Al-Nasser and Jackson (2012) using different dataset and econometric techniques established significantly negative effects of high inflation on financial sector development. In particular, focusing on entire banking sector and stock market, Al-Nasser et al. (2012) employed a panel data methodology on pooled data for 15 Latin American countries from 1978-2003 and established a significantly negative relationship between inflation and banking sector development. They also found high inflation to depress stock market development in Latin America countries.

Using a panel methodology on time series data from 1960s to early 1990s involving both bank-based and market-based financial development indicators, Haslag and Koo (1999) and Boyd et al (2001) reported that moderate inflation has a negative effect on financial development. They also indicated an evidence of nonlinearities after a particular threshold of inflation. For instance, Boyd et al (2001) found a discrete drop in financial performance for countries with inflation exceeding 15% (also see, Khan et al, 2001)[8]. The intuition is that the damage on financial development is done at rates of inflation lower than the proposed threshold. However, using a Generalized Method of Moment with a dynamic panel model of 11 Middle East and North African (MENA) Countries, Ghazouani (2005) found no evidence of threshold effect even after controlling for simultaneity and omitted variable biases. He however established a significant negative inflationary effect on financial development.

By means of Pooled Mean Group estimator of Pesaran and Shin (1998) on a panel data for 87 countries (1960-2005), Kim, Lin and Suen (2010) also found evidence of a much larger negative long run effect of inflation on financial development. They however established a positive short run effect, indicating that higher inflation stimulate financial activities in the short run (see, also Abbey, 2012). This result was robust irrespective of

[7] According to McKinnon (1973) and Shaw (1973), financial repression, in some instances, repression is a basic attempt to protect certain sectors from inflation. In other case, financial repression that is introduced to help the government finance its own activities is a cause of both inflation and resource misallocation.

[8] Using a large cross-country sample, Khan et al (2001) found empirical evidences of threshold effect of inflation of about 3-6% per annum depending on the specific measure of financial development.

alternative financial development measures, control variables and inflation uncertainty proxies.

Similarly, Keho (2009) employed Bound Test Cointegration approach (proposed by Pesaran et al, 2001) and Granger causality test (suggested by Toda and Yamamoto, 1995) to analysis time series data of UEMOA countries. He found evidence of long run relationship between inflation and financial development for six countries. He also found financial development to cause inflation in four countries with the reverse causality detected in only two countries.

In addition, Bittencourt (2008) employed both time series and panel datasets from 1985-2002 using different estimators and financial development measures to examine the link between the two in Brazil. He established that inflation has deleterious effects on financial development at the time. Among the measures used to proxy financial development, M3/GDP and Credit to private sector/GDP ratio had the largest detrimental effect of inflation during the period in all the dynamic equations. Intuitively, this emphasizes the importance of inflation in negatively affecting a measure which is broader than M2 (by definition) and also would not be much affected by financial repression. This suggests that inflation adversely influences the provision of payment-deferring instruments that play a critical role during crisis and also curtails the amount of credit in the economy with all its harmful effects on longer and shorter-term projects.

However, in a framework of increased production of 'financial services' whereby households either hold real money balances or make purchases with costly financial services produced by firms, English (1998) found higher inflation to boost the size of the 'financial services' sectors. Thus, in the model, household were found substituting purchased transaction services for real money balances, indicating a positive inflationary effect on financial development.

In synthesis, it can be observed that existing theoretical literature strongly suggests a negative relationship between inflation and financial development but available empirical literature seems to present a mixed conclusion.

3.   Data and Preliminary Analysis

This study employed annual time series, spanning the period 1964-2012. The dataset was obtained from African Development Indicators (ADI) of World Bank and Bank of Ghana. Following Ross et al (1999) and Boyd et al (2000), the current study focused on two measures of financial intermediation. One measure is Liquid Liabilities which is defined as the ratio of liquid liabilities of the financial system (M2) to GDP. We consider this variable as a proxy of financial depth because it represents the broadest available indicator of financial intermediation, since it includes all the three financial groups namely central banks, deposit money banks and other financial institutions as defined in the International Financial Statistics (IFS). The implicit assumption is that the size of the financial system is positively related to the provision of financial services. The second and most preferred financial intermediary development measure is Private Credit (scaled by GDP) which assesses the extent to which banking institutions channel credit to private sector activities. The credit ratio reflects the overall level of the financial intermediation in an economy. It however excludes credits issued to government, government agencies and public enterprises. According to Levine et al (2000), this indicator is not merely a measure of size but has been found to exert a causal impact on economic growth. Although these indicators are still defective in measuring how well financial intermediaries research firms, monitor managers, mobilize savings, pool risk, and ease transaction, they are able to provide more information about the extent of development of financial intermediaries (Ross et al, 1999). For inflation, the study computed the logarithm of consumer price index (CPI). Preliminary investigation of the inflation-finance link from 1965-2012 was carried out using pairwise correlation analysis. The scatter plot in figure 4 shows the result from the simple correlation analysis.
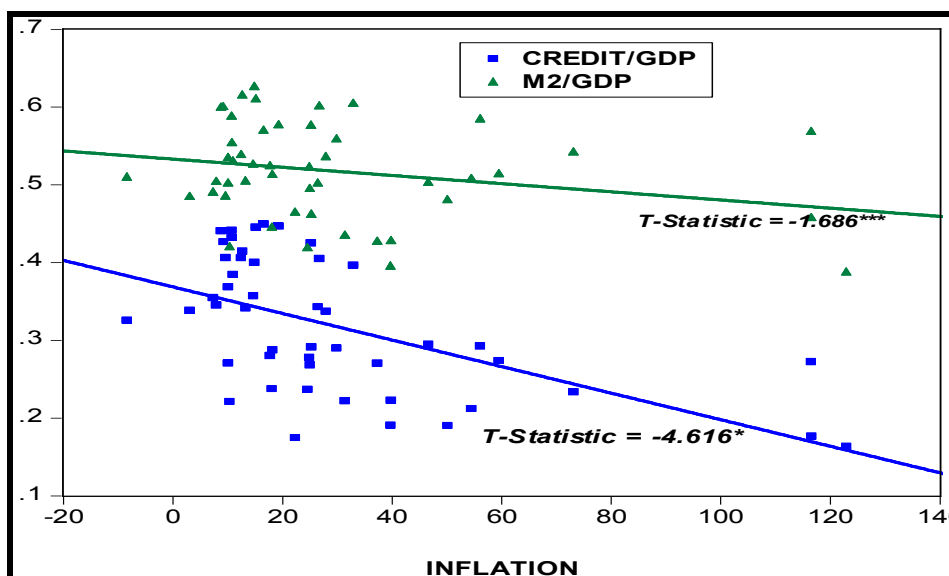
Figure 4: Scatter Plot for Inflation and Financial Development

First, it can be seen that all measures of financial development and inflation are negatively correlated. Secondly, the correlation appears to be much steeper and highly significant (at 1% alpha level) between inflation and domestic credit to private/GDP than that between inflation and M2/GDP (significant at 10% alpha level). This suggests that inflation tends to negatively affect those measures that provide long term funds to be invested in projects and self-employment activities that generally take place in the short run in most developing countries. The study proceeds to carried out time series regression to further investigate the statistical and economic relationship observed between inflation and financial development.

4.   Methodology and Empirical Results

In terms of model specification, the study analyzed both long and short run dynamics using a battery of econometric techniques including Johansen Cointegration tests, Vector Error Correction Models (VECM), impulse response as well as variance decomposition. All these techniques were based on an unrestricted VAR model below to determine the appropriate lag length;

$$z_t = A_0 + \sum_{j=1}^{p} z_{t-j} A_j + \varepsilon_t, \quad \text{............................} \quad (1)$$

Where j, denotes the lag length, determined by the model that minimizes the Akaike Information Criterion (AIC) and Schwarz Bayesian Information Criterion (SBC); z_t is a vector of non-stationary I(1) endogenous variables (including the indicators of financial sector development, inflation, GDP per capita, trade openness and government final consumption expenditure); ′A′s denotes a vector of coefficients.

Since Johansen (1998) Cointegration test requires that the variables are non-stationary and are integrated of the same order, the variables in the analysis were subjected to two types of unit root tests to determine whether they are stationary or unit root series. Here, the study used Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) tests, both of which considered the null hypothesis of a presence of unit root. The tests were carried out using no constant and trend, with constant, and with time trend and the results are shown in table 1.

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Table 1: Unit Root Test of Variables in levels and First Difference

Variable	Levels			First Difference
	None	Intercept	Intercept & Trend	
Augmented Dickry-Fuller (ADF) Test				
LPSC/GDP	-0.645	-0.896	-1.420	-6.406*
LM2/GDP	-0.524	-1.336	-1.877	-6.998*
LCPI	-0.157	-0.351	-0.876	**-3.857***
TRADE/GDP	-0.808	-1.746	-2.052	-4.724*
GEXP/GDP	-0.397	**-3.052**	-2.883	-5.826*
LYGDP	1.734	1.978	0.813	**-6.337***
Philip-Perron (PP) Unit Root Test				
LPSC/GDP	-0.643	-0.984	-1.411	-6.395*
LM2/GDP	-0.524	-1.516	-2.014	-6.994*
LCPI	-0.597	-0.382	-1.511	-3.915*
TRADE/GDP	-0.808	-1.486	-1.835	-4.569*
GEXP/GDP	-0.399	-2.643	-2.582	-5.830*
LYGDP	1.527	1.854	0.270	-5.180*

*Note: *, ** and *** denote 1%, 5% and 10% significant levels respectively*

From table 1, the ADF results show that all variables are integrated of order one as they become stationary after first difference. This ADF result was also reinforced by the PP test statistics. The PP results could not reject the null hypothesis of the presence of unit roots in the series at levels, but could not accept the null after first difference.

In addition, the appropriate lag length was examined with an unrestricted VAR system comprising each measure of financial development (PSC/GDP or M2/GDP), inflation (LCPI), real GDP per capita (LYGDP), government final consumption expenditure (scaled by GDP, LGEXP) and trade openness (scaled by GDP, TRADE) using information criteria such as AIC, SBC and HQ. Essentially, the selection of appropriate lag was based on a stability of the VAR and result is shown in table 2.

Table 2: VAR Lag Order Selection Criteria

Lag	LogL	FPE	AIC	SC	HQ
Endogenous Variables: LM2 INF TRADE GEXP LYCAP					
0	91.2332	1.49E-08	-3.832586	-3.631846	-3.757753
1	373.1337	1.65E-13	-15.25039	**-14.04594***	**-14.80138***
2	399.7812	1.60e-13*	-15.32361*	-13.11547	-14.50044
3	423.3176	1.91E-13	-15.25856	-12.04671	-14.06121
4	443.6415	2.96E-13	-15.05073	-10.83519	-13.47922
Endogenous Variables: LPSC INF TRADE GEXP LYCAP					
0	195.107	1.84E-10	-8.226979	-7.825498	-8.077311
1	354.4528	4.75e-13*	-14.1979	**-12.79272***	**-13.67406***
2	379.9736	4.90E-13	-14.22105*	-11.81217	-13.32304
3	403.3716	6.00E-13	-14.14985	-10.73726	-12.87767
4	419.2798	1.17E-12	-13.74577	-9.329484	-12.09942

Note: VAR however met all diagnostics at lag length One
 * *indicates lag order selected by the criterion*
 FPE: Final prediction error
 AIC: Akaike information criterion
 SC: Schwarz information criterion
 HQ: Hannan-Quinn information criterion

From table 2, AIC selected lags two, while both SBC and HQ chose lag one. However, the VAR specification with lag one was found to be stable and met all the other diagnostics tests. Therefore, the paper carried out various analyses using lag one.

4.1 Bivariate Regression Results

Prior to Johansen multivariate analysis, the study carried out bivariate analysis to examine the relationship between the two interested variables excluding all other influencing factors. Here, Pairwise Granger causality test was used to detect the direction of causality, while Granger (1981) two-step method was also employed for

bivariate error correction analysis. This was deemed necessary as the negative correlation coefficient between two variables does not connote direction of causality. Since the variables are integrated of the same order, Granger causality between inflation and other variables were formally tested using the following two vector autoregressive models:

$$inf_t = \alpha_1 + \sum_{i=1}^{k} \varphi_i fin_{t-i} + \sum_{j=1}^{p} \beta_j inf_{t-j} + \varepsilon_t, \ldots\ldots\ldots\ldots\ldots\ldots. (2)$$

$$fin_t = \alpha_2 + \sum_{i=1}^{k} \varphi_i fin_{t-i} + \sum_{j=1}^{p} \beta_j inf_{t-j} + v_t, \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where fin_t denotes the interested variable such as measures of financial development; inf_t denotes log CPI. Here, the interested parameters are φ_i and β_j, so causality is assessed based on their significance. Thus, there is Granger causality from financial development to inflation if $\varphi_i \neq 0$ and $\beta_j = 0 \ for \ all \ i$. Similarly, there is causality from inflation to financial development if $\varphi_i = 0$ and $\beta_j \neq 0 \ for \ all \ i$. The causality is said to be bi-directional if $\varphi_i \neq 0$ and $\beta_j \neq 0 \ for \ all \ i$. Finally, there is no link between inflation and financial development if $\varphi_i = 0$ and $\beta_j = 0 \ for \ all \ i$. The results from pair-wise Granger-causality tests are shown in table 3 below.

Table 3: Pairwise Granger Causality Tests Results

Private Credit (LPSC) and Inflation (INF)				
	lag	Obs	F-Statistic	Probability
LPSC does not Granger Cause INF	1	47	9.965	**0.003***
INF does not Granger Cause LPSC			3.000	**0.090*****
LPSC does not Granger Cause INF	2	48	1.175	0.318
INF does not Granger Cause LPSC			3.441	0.041*
LPSC does not Granger Cause INF	3	46	0.316	0.813
INF does not Granger Cause LPSC			3.076	0.038**
Broad Money (LM2) and Inflation (INF)				
INF does not Granger Cause LM2	1	47	0.08447	0.772
LM2 does not Granger Cause INF			1.90922	0.173
INF does not Granger Cause LM2	2	48	1.77302	0.182
LM2 does not Granger Cause INF			1.0972	0.343
INF does not Granger Cause LM2	3	46	3.90695	**0.015****
LM2 does not Granger Cause INF			1.8159	0.160

Note: *, ** and *** denote 1%, 5% and 10% significant levels respectively

The test results indicated a dual causality between private sector/GDP ratio and inflation rate at lag one but inflation effect predominates after the first period and peters out after the third period. The relationship between inflation and broad money/GDP ratio, on the other hand, was found to be unidirectional after the third period. The directional of causality run from inflation to M2/GDP but lingers for a longer period. The above result suggests that inflation and financial intermediation (Private Credit/GDP) Granger cause each other (two-way causality), but there is a unidirectional causality from inflation to financial deepening (M2/GDP).

In addition, since all the variables are integrated of the same order I(1) from both ADF and PP tests, the paper carried out bivariate long run cointegration analysis using Granger (1981) Two-Step procedure to examine the long run properties of inflation and financial developments in a behavioural equation. As the method stipulates, each measure of financial development was initially regressed on inflation at levels to obtain the residual (error) terms and then proceeded to estimate a second regression in first difference which included the generated error terms (in levels) at lag one. The results from Granger two-Step method for inflation and each financial development indicator is shown in table 4.

Table 4: Granger Cointegration Test Results for Financial Development

	Model 1	Model 2
Variables	$\Delta LPSC/GDP_t$	$\Delta LM2/GDP_t$
C	0.062 [2.762]*	0.031 [2.625]**
ΔINF_t	-0.513 [-3.058]*	-0.262 [-3.104]*
$LPSC\_RESID_{t-1}$	**-0.146 [-2.725]***	
$LM2\_RESID_{t-1}$		**-0.109 [-1.733]***
R-squared	0.208	0.226
S.E. of regression	0.090	0.050
Breusch-Godfrey Serial Correlation LM Test:	[3.027]	[0.704]
White Heteroskedasticity Test:	[1.616]	[3.416]
ARCH Test:	[0.318]	[0.928]
Ramsey RESET Test:	[1.331]	[1.126]
Normality (Jacque-Bera Test)	[1.640]	[5.134]***

Note: *, ** and *** denote 1%, 5% and 10% significant levels respectively while [ ] denotes t-statistics.

Table 4 shows both the short and long run effects of inflation on financial development where the latter is the dependent variable. Both residuals terms are negative as expected and significant. This suggests that a long run relationship exists between inflation and financial development. In the short run, inflation effect was also found to be negative and statistically significant in all models. Similarly, the short run impact of inflation seems to larger on private credit/GDP than on broad money/GDP. This indicates that the negative inflation impact is relatively larger on financial intermediation than on financial deepening, which is consistent with scatter plot and also corroborates with the findings of Bittencourt (2008). This raises concern as reduction in credit delivery, underpinned by rising inflation rates, tends to have adverse influence on economic growth.

As the Granger causality test indicated dual causality between inflation and financial development especially with Private credit/GDP ratio, the study further examined both the short and long run effects of financial development on inflation. This was however motivated by the assertion of Dordunoo et al (1998) that inflation tends to decelerate as financial sector developed. Table 5 presents the bivariate analysis from Granger (1981) Two-Step ECM method with inflation as a dependent variable.

Table 5: Granger Cointegration Test Results for Inflation

	Model 1	Model 2
Variables	ΔINF_t	ΔINF_t
C	0.067 [3.594]*	0.067 [3.869]*
$\Delta LPSC/GDP_t$	-0.252 [-2.071]**	
$\Delta LM2/GDP_t$		-0.615 [-3.063]*
ΔINF_{t-1}	0.408 [2.894]*	0.413 [3.132]*
$INF\_LPSC\_RESID_{t-1}$	**0.007 [0.913]**	
$INF\_LM2\_RESID_{t-1}$		**-0.0002 [-0.029]**
R-squared	0.259	0.334
S.E. of regression	0.258	0.073
Breusch-Godfrey Serial Correlation LM Test:	[2.221]	[1.894]
White Heteroskedasticity Test:	[4.601]	[5.965]
ARCH Test:	[0.689]	[0.342]
Ramsey RESET Test:	[0.222]	[0.813]
Normality (Jacque-Bera Test)	[19.950]*	[10.956]*

Note: *, ** and *** denote 1%, 5% and 10% significant levels respectively while [ ] denotes t-statistics.

The study found no long run effect of financial development on inflation. However, the corresponding short run coefficients were negative and significant. This suggests that financial development tends to dampen inflationary pressures in the short run but have no effect in the long run. The result corroborates with Dordunoo et al (1998) but contradict with the findings of Abbey (2012). It also supports the results from the Granger causality tests that financial intermediation (private credit/GDP) and inflation affect each other in the short run.

In term of the size of impact, broad money/GDP tends to exert larger negative effect on inflation than private credit/GDP, which also corroborates with the findings of English (1998). Intuitively, a well-developed financial system with viable options of financial services has the tendency to reduce households' preference from holding real money balances towards investing in costly but rewarding financial instruments. In sum, the bivariate ECM analysis from Granger (1981) Two-Step procedure established a bi-directional causality between inflation and financial development in the short run but showed uni-directional causality in the long run from inflation to financial development.

4.2 Johansen Multivariate Cointegration and VECM Results

The study further examined the long run relationship between inflation and financial development using multivariate Johansen Cointegration test to control for other factors that influence the dynamic link between the two. Johansen Cointegration analysis included measure of financial development (PSC/GDP or M2/GDP), inflation (LCPI), real GDP per capita (LYGDP), government final consumption expenditure (scaled by GDP, LGEXP) and trade openness (scaled by GDP, TRADE). Having identified the non-stationarity, order of integration and the lag length, Johansen Cointegration test was carried out using likelihood ratio test which is based on the trace of the matrix (Trace statistic[9]). The Trace statistic considers the null hypothesis that the number of distinct cointegrating vectors is less than or equal to r, against a general unrestricted alternative that the rank equals r+1. Table 6 presents the results from trace tests which imposed the restrictions of deterministic and no deterministic linear trend for each measure of financial development and other variables.

Table 6: Johansen Cointegration Tests Using Trace Statistic

Series: LM2 INF TRADE GEXP LYCAP		
Trend assumption: No Deterministic Trend (Restricted constant)		
Null Hypothesis	Eigenvalue	Statistic
r = 0	0.649	99.99*
r ≤ 1	0.352	50.73***
r ≤ 2	0.301	30.35
Trend assumption: Linear Deterministic Trend		
r = 0	0.628	85.20*
r ≤ 1	0.335	38.73
r ≤ 2	0.227	19.57
Series: LPSC INF GEXP TRADE LYCAP		
Trend assumption: No Deterministic Trend (Restricted constant)		
r = 0	0.561	102.64*
r ≤ 1	0.482	63.91*
r ≤ 2	0.300	32.96***
Trend assumption: Linear Deterministic Trend		
r = 0	0.541	86.97*
r ≤ 1	0.392	50.42**
r ≤ 2	0.292	27.01

*Note: *, ** and *** denote 1%, 5% and 10% significant levels respectively.*

The test results confirms the outcome form the Engel-Granger bivariate procedure as it indicates the existence of at least one cointegrating equations in respective models for LM2/GDP and LPSC/GDP. This suggests that a long run relationship exists between inflation and financial development after controlling for other factors that influence the two and that the bivariate results did not suffer from omitted variables.

The error correction model is useful as Johansen Cointegration has confirmed a multivariate long run relationship among the five variables. Since the Johansen method does not isolate the short run from the long run dynamics, the paper proceeded to estimate the Vector Error Correction Model (VECM) by deriving the VECM form in equation (4) below from its unrestricted VAR form in equation (1);

$$\Delta z_t = A_0 + \Pi z_{t-1} + \Delta z_{t-j}\Gamma_j + \varepsilon_t, \dots\dots\dots\dots\dots(4)$$

Where $\Pi = -(1 - A_1 - A_2 - \cdots - A_p)$, $\Gamma_j = (1 - A_1 - A_2 - \cdots - A_p)$, $j = (1, 2, 3, ..., p-1)$.

The Π matrix contains information regarding the long run relationship which is decomposed as $\Pi = \alpha\beta'$ where α

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[9] See Asteriou and Hall (2007) for details on ADF, Johansen Cointegration test and Trace statistic.

includes the speed of adjustment to equilibrium coefficients and β′ contains the long run matrix of coefficients. The results from the VECM estimations are displayed in table 7, indicating both the long run and short dynamics between inflation and financial development.

Table 7: Results from Vector Error Correction Model (VECM)

Long Run Equations		
Independent Variables	**LPSC/GDP _t_**	**LM2/GDP _t_**
INF _t-1_	-0.116[-7.450]*	-0.048 [-4.176]*
LTRADE _t-1_	0.917 [8.565]*	0.531 [6.506]*
LGEXP _t-1_	0.681 [2.483]*	0.073 [0.351]
LYCAP _t-1_	2.858 [9.094]*	1.382 [5.823]*
Constant	-9.609	-4.325
Short Run Equations		
ΔPSC/GDP _t-1_	0.2198 [1.179]	
LM2/GDP _t-1_		0.097 [0.679]
ΔINF _t-1_	0.023 [0.129]	0.346 [2.673]*
ΔGEXP _t-1_	-0.364 [-1.271]	0.003 [0.023]
ΔTRADE _t-1_	0.216 [1.253]	0.016 [0.193]
ΔLYCAP _t-1_	0.675 [0.914]	-0.195 [-0.517]
Constant	-0.004[-0.184]	-0.032[-2.131]*
ECM _t-1_	**-0.271 [-1.755]****	**-0.359 [-4.314]***
R-squared	0.216	0.402
Sum sq. resids	0.352	0.083

Note: *, ** and *** denote 1%, 5% and 10% significant levels respectively while [ ] denotes t-statistics.

As shown in table 7, the error correction term (**ECM**_t-1_) is negative as expected and significant in both models. This suggests that a long run equilibrium relationship indeed exists among financial development, inflation, and three control variables. The ECM term which also signifies the speed of adjustment from disequilibrium was relatively weak in private credit/GDP model as it was significant at 10% alpha level, compared with the 1% alpha level in M2/GDP model. Likewise, the speed of adjustment was found to be slower at 27% with private credit/GDP ratio compared with M2/GDP model (36%).

Regarding the estimated parameter of interest, the long run coefficient of inflation was negative and significant in both models, suggesting that inflation tends to hinder financial development in the long run. In addition, long run effect of inflation was larger on financial intermediation (Private Credit/GDP) than on financial deepening (M2/GDP), which corroborates with preceding results and also consistent with findings of Bittencourt (2008) and Kim et al (2010). This is indeed worrisome as reduction in private credit during inflationary period tends to curtail investments in capital and human in an economy, and hence adversely impact on long term economic growth. In the short run, however, the result was somehow mixed. The effect of inflation on financial deepening (M2/GDP) was significantly positive (consistent with English, 1999), while no significant effect was found on financial intermediation (Private credit/GDP). In addition, inflationary effect on financial deepening was stronger in the short run than in the long run which reinforces the bivariate results from Granger Two-Step procedure.

With respect to control variables, real GDP per capita, trade openness and government consumption expenditure appear to have much stronger and significantly positive long run effects on financial development. Surprisingly, they exhibited no significant effect on financial development in the short run.

Additional insight of causality between inflation and financial sector development was obtained by analyzing the impulse response and variance decomposition functions from within a VAR framework. In this case, a shock to any one of the variables in the VAR affects not only the variable itself but is also transmitted to other endogenous variables through a dynamic lag structure of the VAR. Thus, shock to an individual variable can generate variations in both itself and other variables. Accordingly, variance decomposition technique was used to track the relative importance of each random shock to the endogenous variables in the VAR, while cumulative impulse response functions was used to specifically trace out the direction of the dynamic responses of variables

to these shock. Both methods were carried out using Cholesky decomposition and standard errors generated from Monte Carlos simulations with 1000 iterations in a 4-variable VAR model. Figures 5 and 6 report the results of average variance decomposition from two different Cholesky orderings where the positions of inflation and financial development indicators were interchanged for 10 periods.
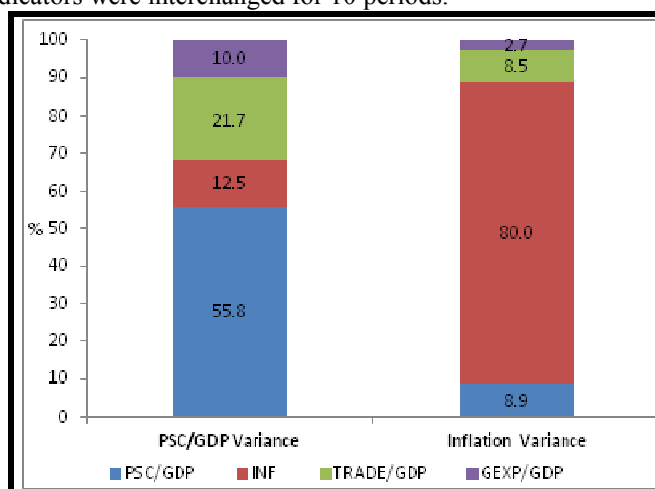
Figure 5: Relative Effects of Credit/GDP and Inflation
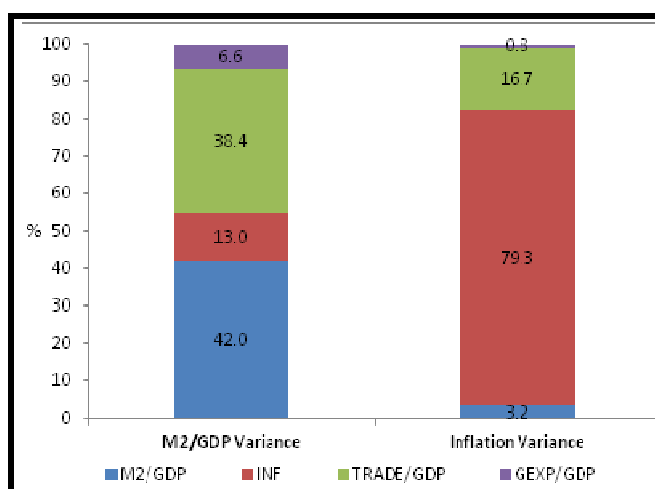
Figure 6: Relative Effects of M2/GDP and Inflation

Consistently, inflation in both figures appears to account for relatively larger proportions of the variations in financial development than the opposite scenario. In terms of the measure of financial development, Private credit/GDP was found to account for rather larger proportion of innovations in inflation than the share of M2/GDP in the movement in inflation.

In addition, the results from the impulse response functions which depict the direction of these movements are shown in tables 8 to 11. These tables show the interested cumulative responses from relative shocks to inflation and financial development indicators in a system. The impulse response functions also reinforce the dual link between inflation and financial development in the short run. Shocks to both inflation and financial development generate negative responses to each other. However, financial development indicators were found to respond instantaneously to inflation innovations, while the inflation response to financial sector shocks was only noticed after the second period. In line with earlier results, the negative response of private credit/GDP to inflation innovations was found to significantly persist up to period 4, while the effect on M2/GDP was found to be one-off.

Table 8: Cumulative Response of Inflation from Credit Shock

Period	LPSC Shock	INF Shock	TRADE Shock	GEXP Shock
1	-0.0290	0.0741	-	-
	[-0.012]*	[-0.008]*	-	-
2	-0.0366	0.0808	-0.0127	0.0060
	[-0.015]*	[-0.011]*	[-0.009]*	[-0.011]*
3	-0.0429	0.0872	-0.0247	0.0126
	[-0.019]*	[-0.014]*	[-0.018]	[-0.018]
4	-0.0484	0.0930	-0.0357	0.0190
	[-0.024]*	[-0.018]*	[-0.025]	[-0.023]
5	-0.0532	0.0982	-0.0454	0.0251
	[-0.030]	[-0.022]*	[-0.033]	[-0.028]
Cumulative Effect	**-0.1570**	**0.4333**	**-0.0127**	**0.0060**

Table 9: Cumulative Response of Credit/GDP (LPSC)

Period	LPSC Shock	INF Shock	TRADE Shock	GEXP Shock
1	0.0896	-	-	-
	[-0.009]*	-	-	-
2	0.0707	-0.0153	0.0305	-0.0200
	[-0.012]*	[-0.008]*	[-0.012]	[-0.012]**
3	0.0570	-0.0224	0.0455	-0.0303
	[-0.016]*	[-0.013]**	[-0.018]	[-0.017]
4	0.0467	-0.0247	0.0513	-0.0346
	[-0.019]*	[-0.015]**	[-0.023]	[-0.020]
5	0.0386	-0.0243	0.0516	-0.0353
	[-0.022]	[-0.016]	[-0.027]	[-0.022]
Cumulative Effect	**0.2640**	**-0.0624**	**0.0305**	**-0.0200**

Table 10: Cumulative Response of M2/GDP (LM2)

Period	LM2/GDP Shock	INF Shock	TRADE Shock	GEXP Shock
1	0.0430	-	-	-
	[-0.005]*	-	-	-
2	0.0266	-0.0143	0.0223	-0.0073
	[-0.007]*	[-0.005]*	[-0.005]*	[-0.006]
3	0.0163	-0.0186	0.0324	-0.0114
	[-0.008]*	[-0.008]*	[-0.008]*	[-0.008]*
4	0.0099	-0.0173	0.0353	-0.0133
	[-0.009]	[-0.009]**	[-0.011]*	[-0.011]
5	0.0059	-0.0135	0.0339	-0.0137
	[-0.011]	[-0.010]	[-0.013]*	[-0.014]
Cumulative Effect	0.0859	-0.0637	0.1239	-0.0114

Table 11: Cumulative Response of Inflation from LM2/GDP Shock

Period	LM2/GDP Shock	INF Shock	TRADE Shock	GEXP Shock
1	-0.0226	0.072357	-	-
	[-0.012]**	[-0.008]*	-	-
2	-0.0145	0.0756	-0.0199	0.0004
	[-0.014]	[-0.011]*	[-0.008]*	[-0.011]
3	-0.0091	0.0732	-0.03192	0.0024
	[-0.016]	[-0.014]*	[-0.015]*	[-0.017]
4	-0.0056	0.0671	-0.0382	0.0047
	[-0.019]	[-0.017]*	[-0.021]	[-0.023]
5	-0.0033	0.0592	-0.0404	0.0066
	[-0.021]	[-0.019]*	[-0.025]***	[-0.026]
Cumulative Effect	-0.0462	0.1488	-0.0900	-

*Note: [ ] denotes standard error; *, ** & *** denote 1%, 5% & 10% significance levels respectively.*

4.3 Robustness

The study further checked the robustness of the above results by examining the structural dynamics of inflation and financial development shocks using reduced form (or lower triangular matrix) identification procedure in a structural VAR model. In the reduced form model, each variable is estimated via OLS as a linear function of its own past terms, the past values of all other variables and error term. The error terms are the surprise movements in the variables after taking past values into account. If the variables are correlated with each other, then the error terms will also be correlated. Here, the study assumed initial shock to government spending to set up a five-variable model with the order; government spending (GEXP), trade openness (TRADE), inflation (INF), private credit/GDP (LPSC) and real per capita income (LYCAP). Arranging these variables in a vector as the same order they were introduced in $\varphi_t = [gexp_t, trade_t, inf_t, lpsc_t, lycap_t]$, the paper considered the following structural model;

$$B_o \boldsymbol{\varphi}_t = \sum_{i=1}^{k} B_i \boldsymbol{\varphi}_{t-i} + \mu_t , \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (2)$$

Where μ_t is a vector of mutually uncorrelated or independent structural innovations. The coefficient matrix B_o reflects contemporaneous relationship among the variables in φ_t. However, we assumed that B_o is a lower triangular matrix since it is not possible to estimate B_o and identify the innovations μ_t without further assumptions. The paper reports both the structural estimates in table 12, while figure 7 displays the structural impulse responses (from the estimates of the structural VAR model) using Cholesky decomposition method and Monte Carlo's standard errors with 1000 iterations for 10 periods.

Table 12: Structural VAR Results using Cholesky Ordering

	GEXP	TRADE	INF	LPSC/GDP	LYCAP
First Ordering; [gexp, trade, inf, lpsc, lycap]					
GEXP	0.0543[0.000]*				
TRADE	0.479 [0.052]**	0.092[0.000]*			
INF	0.115 [0.525]	-0.273 [0.008]*	0.065[0.000]*		
LPSC/GDP	0.336 [0.115]	0.164 [0.200]	**-0.285 [0.091]***	0.077[0.000]*	
LYCAP	0.037 [0.484]	-0.023 [0.468]	-0.023 [0.585]	0.012 [0.732]	0.018[0.000]*
Second Ordering; [gexp, trade, inf, lpsc]					
GEXP	0.055 [0.000]*				
TRADE	0.348 [0.173]	0.097 [0.000]*			
INF	-0.003 [0.984]	-0.195 [0.055]**	0.068 [0.000]*		
LPSC/GDP	0.472 [0.027]**	0.053 [0.666]	**-0.397 [0.017]***	0.079 [0.000]*	-

Note: *, ** & *** *denote 1%, 5% & 10% significance levels respectively, while [ ] denotes P-values.*

The results from the structural VAR also reinforce the earlier findings. As exhibited in table 12, inflation innovations impact negatively on financial development (private credit/GDP). The structural impulse response in figure 7 also confirms the two-way negative link between inflation and financial development.

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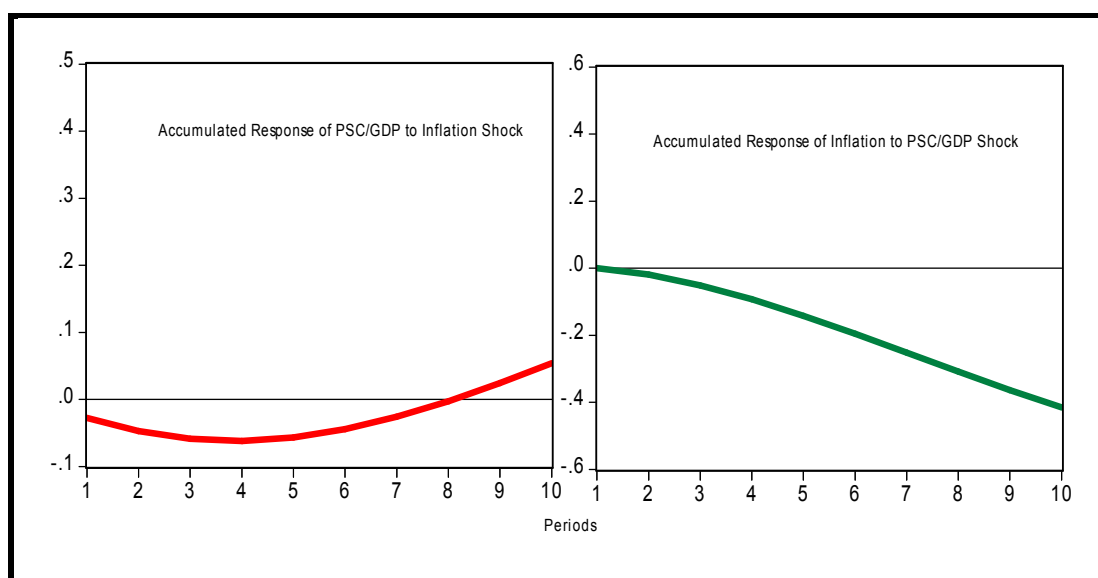
Figure 7: Relative Accumulated Responses to Structural One S.D. Innovations

While the financial sector effect of inflation innovations is spontaneous, there is a delayed (lagged) effect from the latter. This is also consistent with the earlier results, suggesting a robust and stable negative relationship between inflation and financial development in the Ghanaian context.

5. Conclusion and Policy Implications

The study investigated the dynamic link between inflation and financial development in Ghana using annual time series from 1964-2012. This paper specifically assessed whether the direction of causality between inflation and financial development differs in the short and long run. This was motivated by the generally acclaimed negative impact of inflation on financial development and a possible reverse negative effect suggested by Dordunoo et al (1998). Consequently, the study employed a sequence of bivariate and multivariate econometric analysis such as simple Correlation analysis, Granger causality test, Granger ECM test, Johansen Cointegration, Vector Error Correction Model (VECM), Variance decomposition, structural VAR and impulse response methods to examine both the short and long run inflation-finance link in the case of Ghana.

The findings of this paper were robust as all the series of techniques adopted yielded the same results as follows; first, there is evidence of a stable short and long run equilibrium relationships between inflation and financial development in Ghana. In the long run, a negative and unidirectional causality was established to be running from inflation to private credit. However, in the short run, a negative bi-directional causality was found between inflation and private credit but the inflationary effects on all financial indicators were rather spontaneous. Second, there was mixed result in terms of the direction of impact of inflation on M2/GDP in the short run, the reverse effect was negative and stable. While positive impact of inflation on M2/GDP in the short run was noticed in the VECM framework, the results from both the impulse response and bivariate ECM however indicated a negative inflationary effect on M2/GDP. Thirdly, the interaction between inflation and private credit/GDP was found to be much stronger than that of inflation and M2/GDP.

The findings of this current study established that inflation has both short and long run deleterious effect on financial development, but there is also a short run feedback effect from the latter. That is, while high inflation rates adversely affect financial intermediation (Private Credit/GDP) both in the short and long run, the dampening effect of financial intermediation on inflation is only a short run phenomenon. This finding however contradicts with the results from Abbey (2012) which established no long run relationship between the two and also no feedback effect of financial development on inflation. Nonetheless, the findings were consistent with Dordunoo et al (1998) which emphasized the dampening effect of financial development on inflation and also corroborates with Bittencourt (2008) and Kim et al (2010) who established long run interaction between inflation and financial development.

However, the positive inflationary effects on M2/GDP seems to lend support to English (1998) who argued that rising inflation compels households to prefer costly but rewarding financial services to holding of large real money balances. The weak link between inflation and M2/GDP also lend support to the adoption of the current monetary policy framework of inflation targeting (IT) in Ghana.

Moreover, as reiterated earlier, this stable negative relationship between inflation and financial development did not happen in a vacuum but as a result of conscientious efforts by authorities to overhaul the entire financial

system alongside prudent macroeconomic management. This reflected significantly in the implementation of numerous economic and financial sector reforms since the late 1970s (example, Economic Recovery Programme (ERP), Structure Adjustment Programme (SAP), FINSAP and FINSSIP). These reforms culminated in financial, exchange rate and trade liberalization, establishment of capital (Ghana Stock Exchange) and money market, rural banking system, entrants of foreign banks which enhanced competition, payment automation systems, strong supervision and regulation, redenomination, and last but not the least, the independence of the Central bank in the implementation of monetary policy. These developments have comparatively strengthened the financial sector and also influenced the dynamics of inflation in Ghana. Notwithstanding, the financial sector is still predominantly cash base with large segment of unbanked rural and informal sector (over 70%), while entrenched fiscal dominance continues to exacerbate inflationary pressures.

To strengthen the dampening effect of financial development on inflation as indicated by the above findings therefore requires a comprehensive policy direction towards improving financial access to the large unbanked informal sector, while effectively promoting cashless economy. This would make the floating funds (currency outside banks) available to the financial institutions to facilitate long term capital investment, reduce pressure on the currency (as currency outside bank will reduced) and also enhance the transmission of monetary policy (as the decisions of the financial institution would now impact on the larger population). Consequently, the author recommends that the current IT framework in Ghana should be given the utmost priority to ensure a low and stable inflation. However, the study highly recommends good and all-embracing financial sector reforms with the objective of targeting the unbanked informal sector and strengthening the financial institutions to effectively enhance the monetary policy transmission mechanism by minimizing the monetary policy lags.

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