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Monetary Policy and Private Sector Credit Interaction in Ghana

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Abstract

Using a series of econometric techniques, the study analysed interaction between monetary policy and private sector credit in Ghana. This study made use of monthly dataset spanning January 1999 to December 2019 of credit to the private sector (PSC) and broad money supply (M2). The results reveal that there exists cointegration, a long run stationary relation between monetary policy and private sector credit. This implies, increases in credit should prompt long-term increases in monetary policy. It is not surprising that growth in the private sector might have a stronger effect on monetary policy. The Error Correction Test is statistically significant and that all the variables demonstrate similar adjustment speeds. This implies that in the short run, both money supply and credit are somewhat equally responsive to their last period's equilibrium error. There is unidirectional causation from private sector credit to monetary policy. It can be said that, there is an interaction between money supply and private sector credit. Thus, credit to private sector holds great potential in promoting economic growth. It can be recommended to the government to increase the credit flow to the private sector because of its strategic importance in creating and generating growth of the economy.

Keywords: Monetary policy; Private sector; Credit; Developing economy; VECM.

1. Introduction

The role of finance in economic development has been an ongoing debate dating back to the work of Schumpeter (1911). Economist in particular have been trying to understand the relationship between monetary policy and various macroeconomic variables including credit, prices , output, etc. Specifically, to find out the real effects of money on the economies of nations if any. Some studies in this direction include Kenton (2018), Kimberly (2018), Imoisi *et al.* (2014), Fasanya *et al.* (2013), Bernanke and Gertler (1995) and Romer and Romer (1989), with the conclusion that money indeed matters since it affects real variables. Hence, its dominance in the policy and academic discussions with respect to private sector credit. Most economists advocate for the use of monetary policy for short run stabilization measures. Failure to pursue the right monetary policies can have serious implications on an economy. Monetary policy works in part by varying credit flows in accordance with standard procedure of monetary policy transmission channel.

Monetary policy is a central bank's actions and communications that manage the money supply. Thus, money supply is a monetary policy tool that is highly essential in boosting economic growth of a nation. The money supply includes forms of credit, cash, checks and money market mutual funds. The most important form is credit which includes loans, bonds and mortgages. Functionally, monetary policy controls inflation, manages employment levels and maintains long term interest rates. Monetary policy is an important instrument used by Central banks of countries to maintain economic stability and promote economic growth, (Prasert *et al.*, 2015). Controlling the quantity, availability and cost of money is geared towards achieving some defined macroeconomic goals such as increased output, stable prices, etc. Monetary policy measures, normally involve lags before they have an effect on real economy. This is because in conducting the policy through the influence of instruments under their control, impulses are relayed to real economy via various channels – interest rate, credit and exchange rate. The interest rate channel is based on the Keynesian IS-LM model where, monetary policy affects the real economy via changes in interest rates.

Monetary policy seeks to impact the rate of aggregate spending by varying the degree of liquidity of various components of the economy including banks, businesses, households, etc. This means, the effect of the action of monetary authorities on the stock of money on the number of currency notes in the people's pockets or the quantity of deposits on the books of the banks. Furthermore, Jelilov and Onder (2016) posits that the change in supply of money can permanently change such variables as the rate of interest, the aggregate demand and the level of employment, output and income.

The ability of monetary policy to influence key macroeconomic variables, such as credit, prices, output, etc. has been well acknowledged in advanced economies. Gertler and Gilchrist (1994), Morsink and Bayoumi (2001), have all clearly established that monetary policy has significant impact on real economic activities. Osasohan (2014) studied the impact of monetary policy on economic growth in the United Kingdom using Vector Error Correction Model (VECM). At the end of the study, money supply and rate of inflation were found to be the major tools of monetary policy used in UK to enhance economic growth.

Mohamed (2016), reported that money supply maintained significant positive influence on economic growth in Sri Lanka. The study investigated the impact of money supply on the Sri Lankan economy, using gross domestic product as the dependent variable while the independent variables were money supply, exchange rate, export earnings, import flows and the consumer price index.

Njimanted *et al.* (2016), used Vector auto-regression (VAR) method to analyze the effect of monetary policy tools on economic growth in the Central African and Monetary Community (CEMAC) and reported that monetary policy tools affect the economic growth of the community.

Similarly, a study by Imoisi *et al.* (2014), using Dickey fuller test, co-integration test and error correction model to test the hypothesis of monetary policy effectiveness, found out that monetary policy exerts moderate impact on the selected macroeconomics variables in Nigeria. Another study on monetary policy effectiveness by Akinjare *et al.* (2016) using ordinary least square method, revealed that, exchange rate, interest rate and money supply are significant in impacting the economy. Inflation on the other hand was found to have insignificant impact on the economy.

Tule *et al.* (2018) presented a review on the efficacy of monetary policy instruments on economic growth influence variables like consumer price index, real exchange rate, money supply and interest rate. The study employed Johansen multivariate co-integration approach and vector error correction model and found that consumer price index, real exchange rate, money supply and interest rate were significant monetary policy instruments that drove economic growth in Nigeria.

Chipote and Palesa (2014) applied Error Correction Model and Johansen Co-integration to investigate the impact of monetary policy on economic growth in South Africa from 2000-2010. The results indicated that, money supply as a monetary policy tool had insignificant influence on economic growth in South Africa. Using Ordinary least Squares (OLS) method and Granger Causality test, Inam and Ime (2017) studied the impact of monetary policy on Nigeria's economic growth from 1970-2012. The study revealed an insignificant positive relationship between money supply and economic growth. A study by Kaman (2014) in Kenya reported that monetary policy did not have a significant impact on economic growth

In Ghana, Havi and Enu (2014) examined the importance of monetary policy and fiscal policy on economic growth from 1980-2012. They applied Ordinary least Squares (OLS) method and realized that money supply had a significant positive impact on the Ghanaian economy. Abradu-Otoo *et al.* (2003) and Allieu and Andrew (2002) agreed that exchange rate is a channel through which monetary policy acts. According to Boamah (2009), monetary policy significantly affected savings rate but not quite potent at regulating inflation. Akosah (2015), also found that output was driven by credit and asset price shocks, while monetary shocks play insignificant role.

A monetary policy shock is defined as the movement in the monetary policy variable which is not a normal, predictable response to the state of the economy. These shocks are exogenous, unexpected and represent a departure of monetary policy from its usual path. In Ghana the current regime of monetary management was put in place in 2002 with the Bank of Ghana Act (Act 612). This Act granted operational independence to the Bank of Ghana through its Monetary Policy Committee (MPC) to conduct independent monetary policy with price stability as its overriding goal.

Private sector refers to institutions and organizations such as financial institutions, business associations, privately owned domestic and foreign corporations and informal sector (Aryeetey and Owoo, 2015). Private sector credit is the financial resources provided to the private sector. Credit can be viewed from two angles, namely, trade or commercial credit and banking system credit. This study focuses on banking system credit to private sector. Égert *et al.* (2006), postulated that financial systems in transition economies are characterized as predominantly bank based with majority of their assets being bank assets with little or no capital market development. This infers commercial bank credit plays the role of being the main source of external financing together with foreign direct investment in transition economies. The private sector in every nation plays a decisive role if that nation is to achieve economic success of ensuring growth and reducing poverty. The story is no different in Ghana where the private sector is seen as the "engine of growth" of the economy. In Ghana, the entities forming the private sector accounts for about 85.6% of the total number of persons engaged by non- household establishment, National Employment Report (2015). This a clear indication that developing and assisting the private sector will go long way in improving the lives of many Ghanaians. There was a further indication from the report that, private sector engagements are in the industry, agriculture and services sectors, which have the highest contribution to Gross domestic Product (GDP). Government activities and programmes for some years now have been private sector driven. Some of the initiatives and policies are: "Made in Ghana" policy which was launched in 2016; National Industrial Revitalization Programme with a stimulus package for industry and a National Entrepreneurship and innovation plan (NEIP). Others are One district one factory initiative; One village one dam and planting for food and jobs policy. However issues with credit have been the main challenge that has bedeviled the private sector in Ghana for a long time and the success of these programs will depend on how stakeholders are able to surmount some the challenges.

Several empirical studies have shown that the efficient provisioning of credit has a positive and significant effect on output and employment opportunities. Molapo and Damane (2015), also shared the same sentiment and

conclude that channeling more credit to the private sector is traditionally a much more efficient to raise a country's economic growth rate. Similarly, private sector involvement in economic activities especially those of the real sector are important to any economy as this leads to the production and distribution of tangible goods and services that satisfy an economy's aggregate demand as well as providing a measure of effectiveness of macroeconomic policies, Mamman and Hashim (2013). Calza *et al.* (2001), be of the same mind, indicated that information on credit and credit allocation is essential in the forecast and analysis of economic activity, prices and monetary developments. Other studies by Rasheed (2011) found private sector credit causing reserve money among others. That of Bellalah *et al.* (2013) also found evidence of long-run relationship between domestic credit to private sector and money supply, whiles Olweny and Chiluwe (2012) explored the relationship between monetary policy and private sector investment in Kenya and reported of a positive relationship between the two variables. It would therefore not be hyperbolic that credit is the foundation upon which businesses are formed, jobs are created, the economy grows and the overall well-being of the citizens of a country is enriched.

It is for this reason that the government of Ghana embarking on structural adjustment programme in 1983, made the promotion of the private sector an integral part of its economic development strategy, (Arthur, 2006). According the World Bank (1994), the Private Sector Development Project adopted in Ghana seeks to foster the development of a competitive private sector by providing to a broad segment of the private sector the necessary financial and technical assistance among others.

The above empirical analysis of the determinants of private sector credit, the relationship with money supply, economic growth, etc., reveal mixed and diverse outcomes. Thus, the results are uncertain and the debate remains inconclusive. This study however, is analyzing the interaction between private sector credit and money supply only in the short and long run periods.

2. Methodology

2.1. Variable Description

Money supply is the quantity of money available in an economy at a particular period of time. In the Ghanaian context, different aggregates are used to measure money supply. However in this study, a broader definition of money (M2) was used. M2 is made up of currency in circulation plus demand deposits plus time and savings deposits.

For the purpose of the study, private sector credit is the bank credit provided to the private sector. It is the financial resources extended to the private sector by banks in the form of loans, non-equity securities and others for which a claim for repayment is established

2.2. Data

This study made use of monthly dataset spanning January 1999 to December 2019 of credit to the private sector (CPS) and broad money supply (M2). The dataset were collected from the Central Bank of Ghana and it has 252 observations. The data sourced were analyzed to determine the causality between M2 and CPS. Before analyzing the causal relationship, data was transformed to natural logarithms and then examined for possible existence of unit roots in the data to ensure that the model constructed later is stationary in terms of the variables used. If a time series has a unit root, then the first difference of the series which is stationary should be used. The stationarity of each series is investigated by employing Augmented Dickey-Fuller unit root test. We further proceed with the VAR time series model to examine the Granger causality and we perform the pair wise Granger Causality test for all the series. To carry out the analysis of the data, the statistical package, E-views version 9 was used.

2.3. Non- Stationarity and Co-Integration

Stationarity as defined by Walter (2014) is "A time series y_t is covariance (or weakly) stationary if, and only if, its mean and variance are both finite and independent of time, and the auto-covariance does not grow over time, for all t and t-s. Non-stationarity exists when the variance is time dependent and goes to infinity as time approaches to infinity. A time series which is not stationary with respect to the mean can be made stationary by differencing. Differencing is a popular and effective method of removing a stochastic trend from a series.

Testing of stationarity, the study used Augmented Dickey-Fuller (ADF) test.

This test is an augmented version of the Dickey-Fuller test to accommodate some forms of serial correlation and used for a larger and more complicated set of time series models. Consider $AR_{(p)}$ equation:

$$y_t = \alpha + \gamma_t \sum_{i=1}^{p} \beta_i y_{t-i} + \varepsilon_t \quad (1)$$

$$\Delta y_t = \mu + \gamma_t + \alpha y_{t-i} + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \varepsilon_t \quad (2)$$

Each equation (1) and (2) has its own critical value which depends on the size of the sample. In each case, the null hypothesis is that there is no unit root, $\gamma = 0$

2.4. Vector Auto-Regression (VAR)

Vector auto-regression an econometric model was used to capture the relationship and independence between important economic variables. VAR can be considered as a means of conducting causality tests or more specifically

Granger causality tests. This requires that lagged values of variable X are related subsequent values in variable Y and any other explanatory variables. VAR model estimates and describe the relationships and dynamics of a set of endogenous variables.

For a set on n time series variables $y_t = (y_{1t}, y_{2t,} \dots, y_{nt})$, a VAR model p ($VAR_{(p)}$) can be written as :

$$y_t = A_0 + A_1 y_{t-1} + A_2 y_{t-2} + \cdots + A_p y_{t-p} + \varepsilon_t \quad (3)$$

Where,

p = the number of lags to be considered in the system

n = the number of variables to be considered in the system.

Y_t is an (n×1) vector containing each of the 'n' variables included in the VAR.

A_0 is an (n×1) vector of intercept terms.

A_i is an (n×n) matrix of coefficients.

ε_t is an (n×1) vector of error terms

In specifying the VAR model, it is critical to determine the lag length of the VAR several authors have defined the various lag length selection criteria including: Akaike Information Criterion (AIC) suggested by Akaike (1974), Swwarz Criterion (SC), 1978 and Hanna – Quinn Information Criterion (HQ), 1979.

AIC $= T\,In|\Sigma| + 2N$

SC $= T\,In|\Sigma| + N\,InT$

HQIC $= T\,In|\Sigma| + 2N\,InT$

Where, $|\Sigma|$ = determinant of the variance / covariance matrix of the residuals.

N = total number of parameters estimated in all equations.

T = number of usable observations.

2.5. Granger Causality

This a technique for determining if one time series is useful in forecasting another. Granger (1969) defined causality as "A variable Y is causal for another variable X if knowledge of the past history of Y is useful for predicting the future state of X over and above knowledge of the past history of X itself. So if the prediction of X is improved by including Y as a predictor, then Y is said to be Granger causal for X". Causality between two variables can be unidirectional, bidirectional and independence. Granger causality testing applies only to statistically stationary time series. The test procedure as described by Granger (1969) is stated as:

$$Y_t = \sum_{i=1}^{n} \alpha_i Y_{t-i} + \sum_{j=i}^{n} \beta_j X_{t-j} + \mu_{1t} \quad (4)$$

$$X_t = \sum_{i=1}^{n} \lambda_i Y_{t-i} + \sum_{j=1}^{n} \sigma_j X_{t-j} + \mu_{2t} \quad (5)$$

Equation (4) postulates that the current Y_t is related to its past values as well as that of X_t and vice versa. Unidirectional causality from X_t and Y_t is indicated if the estimated coefficient on the lagged X_t are statistically different from zero as a group (i.e.$\sum \beta_j \neq 0$) and the set of estimated coefficient on the lagged Y_t are not statistically different from zero if $\sum \lambda_j \neq 0$.

2.6. Long-Run Model Specification

Broadly, the existence of cointegration signifies that there is at least one long-run equilibrium relationship among the variables. In this case, Granger causality exists among these variables in at least one way (Engle and Granger, 1987).

To investigate a long run relationship between variables monetary policy and private sector credit, the following cointegrating regression model is used:

$$M2_t = \delta_0 + \delta_1 CPS_t + \mu_t \quad (6)$$

Where *M2* is the dependent variable and is the observations of monthly money supply at time *t, CPS_t* is the monthly observations of the credit to the private sector at time t, δ_1 is the coefficient of CPS_t and shows its impact on money supply. μ_t is the random disturbance term. We conduct an Engle-Granger test for cointegration using the residuals.

To test for long-run relationship and hence cointegration between money supply and private sector credit, we adopt two methods: the Engle-Granger (EG) cointegration test and the cointegrating regression Durbin-Watson (CRDW) test. We run the Engle-Granger (EG) test for cointegration by using the residuals from (eq 6) in an auxiliary regression of the form:

$$\Delta\mu_t = \rho\mu_{t-1} + \varepsilon_t$$

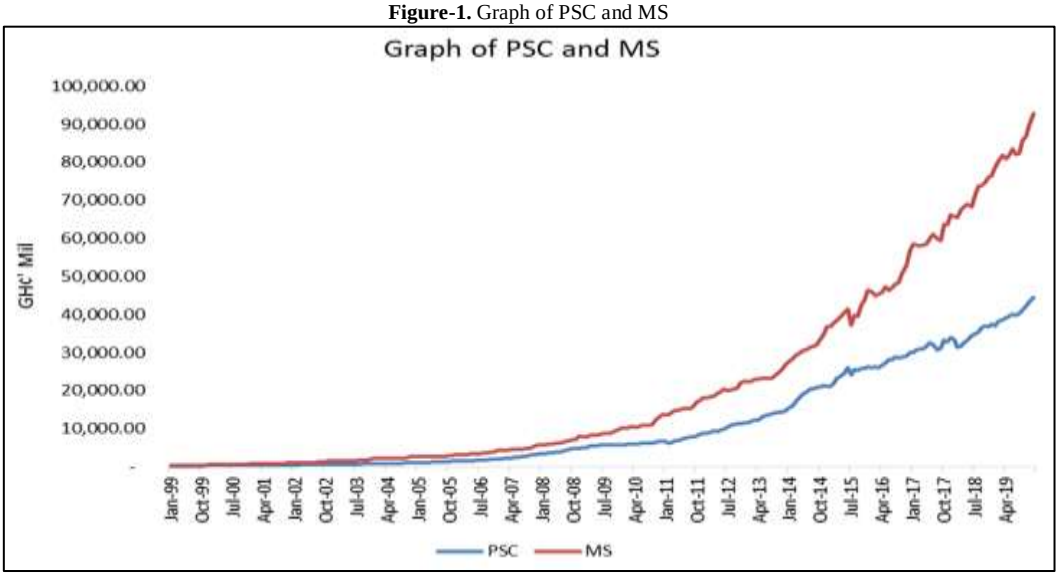
3. Empirical Results

Table-1. Descriptive Statistics

	MS	PSC		LNPSC	LNMS
Mean	20893.65	11121.88	Mean	8.283644	8.947803
Median	8657.827	5633.189	Median	8.636430	9.066210
Maximum	92910.22	44485.25	Maximum	10.70291	11.43939
Minimum	392.6746	167.8146	Minimum	5.122860	5.972981
Std. Dev.	24981.26	12812.66	Std. Dev.	1.684181	1.626235
Skewness	1.246206	1.024407	Skewness	-0.22076	-0.19487
Kurtosis	3.346723	2.633526	Kurtosis	1.714868	1.819515
Jarque-Bera	66.48946	45.48538	Jarque-Bera	19.38822	16.22713
Probability	0.000000	0.000000	Probability	0.000062	0.000299
Sum	5265199.	2802714.	Sum	2087.478	2254.846
Sum Sq. Dev.	1.57E+11	4.12E+10	Sum Sq. Dev.	711.9526	663.8047
Observations	252	252	Observations	252	252

The summary statistics for the dataset used in the study period is presented in table 1. The means as well as the variance do not differ significantly across the variables. The variables are negatively skewed with positive kurtosis. From the summary statistics, standard deviation estimates indicates that the variables are note volatile. Using the p-values associated with Jarque-Bera statistics, it significantly rejects the normal distribution for the variables indicating a non-normality of their unconditional distributions.

Figure-1. Graph of PSC and MS



3.1. Tests for Unit Root

Table-2. Unit Root Test - Level

Variables	ADFTest	Critical value		
	Stat	1%	5%	10%
LNMS	-2.066829	-3.456302	-2.872857	-2.572875
LNPSC	-3.347533	-3.456302	-2.872857	-2.572875

*Mackinnon (1996) one-sided p-values

Table 2 displays the summary of results of Augmented Dickey-Fuller test. It shows a presence of unit root in LNMS. Since the values of computed ADF test-statistic of LNMS is greater than the critical values at 1%, 5% and 10% levels of significance, the null hypothesis cannot be rejected. This indicates the series is not stationary. However, there is the presence of unit root in LNPSC at 1% but significant at 5% and 10% levels. To make them stationary at all levels, first difference is taken as: DLNMS and DLNPSC.

Table-3. Unit Roots Tests - First Difference

Variables	ADFTest	Critical value			Prob.*
	Stat	1%	5%	10%	
DLNMS	-14.20479	-3.456408	-2.872904	-2.5729	0.0000
DLPSC	-14.03239	-3.456408	-2.872904	-2.5729	0.0000

*Mackinnon (1996) one-sided p-values

Applying the Augmented Dickey-Fuller test after taken the difference gives the result in table 3. There is the absence of unit root for each of the p-values of the two series. The calculated ADF test-statistic for both series are smaller than the critical values at 1%, 5% and 10% levels of significance, respectively with different lag lengths based on the Schwarz Information Criterion. Hence, the two series are stationary

Table-4. VAR Lag Length

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-314.911	NA	0.044616	2.566081	2.594498	2.577522
1	1126.680	2848.164	3.93e-07	-9.074333	-8.989084*	-9.040011*
2	1131.527	9.497264	3.90e-07	-9.081189	-8.939108	-9.023986
3	1135.344	7.417567	3.91e-07	-9.079707	-8.880794	-8.999623
4	1141.282	11.44416*	3.85e-07*	-9.095403*	-8.839658	-8.992438
5	1144.146	5.472943	3.88e-07	-9.086204	-8.773627	-8.960358

A VAR Lag order selection process was undertaken and results for the various selection criteria are listed in table 4. The SC and HQ select 1lag and the rest selected 4 lags including AIC. In this work we adopt the AIC criteria of 4lags.

Table-5. VAR stability Condition Check

Root	Modulus
0.996944	0.996944
0.960825	0.960825
0.126934	0.126934
0.077824	0.077824

To assess the validity of the VAR, there is the need to test for the stability of the residuals. No root lies outside the unit circle. VAR satisfies the stability condition.

Table-6. Granger Causality Wald Tests

Equation	Excluded	Chi2	df	Prob >chi2
LNMS	LNPSC	6.099980	2	0.0474
LNMS	All	6.099980	2	0.0474
LPSC	LNMS	5.385409	2	0.0677
LPSC	All	5.385409	2	0.0677

There is a strong evidence that lagged private sector credit helps predict money supply (the p-value is 0.0474). However, lagged money supply is insignificant as far as prediction of private sector credit is concerned (p-value of 0.0677). It is not surprising that growth in the private sector might have a stronger effect on the money supply. Thus, there is unidirectional causation from private sector credit to money supply. This finding is unswerving with financial development theory (Levine, 2005), which suggests that financial innovations expand the depth and breadth of financial intermediation. The finding is also consistent with the long-run cointegration equation, which reveals a positive and significant effect of private sector credit on money supply.

3.2. Cointegration Test

The Johansen cointegration test allows for the estimation of long run relationship between the dependent variable LNMS and the independent variable LNPSC. Both the trace test and max-eigenvalue indicated 2 cointegration equations at the 0.05 level, hence a stable equilibrium relationship is present.

Table-7. Johansen Cointegration Tests

Hypothesized		Trace	0.05	
No. of Ce(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.047056	17.64561	15.49471	0.0234
At most 1*	0.022412	5.644114	3.841466	0.0175

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon *et al.* (1999) p-values

Table-8. Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized		Max-Eigen	0.05	
No. of Ce(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.047056	12.00149	14.2646	0.1106
At most 1*	0.022412	5.644114	3.841466	0.0175

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon *et al.* (1999) p-values

Table-9. Normalised cointegrating equations

1 Cointegrating Equation(s)	**Log Likelihood**	**1143.162**
Normalized cointegrating coefficients (standard error in parentheses)		
LNMS	LNPSC	
1.000000	-0.787608 (0.05402)	
Adjustment coefficients (standard error in parentheses		
D(LNMS)	-0.014350 (0.00556)	
D(LNPSC)	-0.014353 (0.00509)	

Table 9 displays the normalized cointegration equation. Analysing it in the VECM allows one to understand how the indices adjust in a specified time period. The long run equation was estimated as:

$$LNMS_{t-1} - 0.772LNPSC_{t-1} - 2.559 = 0$$

Due to the normalization process, the signs are reversed to enable proper interpretation.

The study focus is on LNMS as the dependent variable, therefore analyzing the impact of LNPSC on money supply, the cointegration vector is normalized with respect to LNMS.

The LNPSC has the expected sign and is statistically significant according to the t values shown. The coefficients are:

$$LNMS_{t-1} = 0.772LNPSC_{t-1} + 2.559$$

This indicates a positive interaction between the two variables. Thus, private sector credit positively affects the supply of money in the economy, a 1% increase in LNPSC leads to 0.79% increase in LNMS in the long run.

3.3. Short Run Dynamics

An error correction framework is constructed to model dynamic response that indicates the speed of adjustment from the short-run to the long-run equilibrium state after cointegration is confirmed. The speed of adjustment back to equilibrium is represented by the error correction term, also known as the adjustment factor (alpha). It is of note that all the variables demonstrate similar adjustment speeds. This implies that in the short run, both money supply and credit are somewhat equally responsive to their last period's equilibrium error, money supply is adjusted by 1.7% and credit by 1.5%.

Table-10. ECM Correction for variables

Error Correction:	**D(LNMS)**	**D(LNPSC)**
CointEq1	-0.017068	-0.015388
	(0.00546)	(0.00506)
	[-3.12806]	[-3.004369]

To examine the dynamic interaction between monetary policy and private sector credit, an innovative accounting techniques called variance decomposition is employed. The result of variance decomposition denotes the 10-year period in table 11. With this the future projection can be predicted as it's usually inferred from the past trends. Two things can be considered here, short run and long run. Considering 3rd period as short run then 10th year is long run. In the short run, impulse or innovation or shock to money supply accounts for 99.99% variation of the fluctuation in money supply that is termed own shock. A shock to private sector credit can influence 0.01% fluctuation in money supply, this depicts that there is short run equilibrium between the two. There is impact but the degree of impact is low between the two variables but for own shock impact is high.

Likewise, it's also observed from the results that, in the short run, shock to money supply accounts for 1.56% variation of the fluctuation in private sector credit and shock to credit contributes 98.44% fluctuation in the variation of private sector credit. Therefore, there is impact of 1.56% to private sector credit in the short run. In the long run the impact of shock to credit contributes 97.83% fluctuation in the variation of the private sector credit and shock on money supply contributes 2.17% variation in the fluctuation in private sector credit.

Table-11. Variance Decomposition

Variance			
Decomposition of			
LNMS:			
Period	**S.E**	**LNMS**	**LNPSC**
1	0.025731	100.0000	0.000000
2	0.037211	99.99921	0.000785
3	0.045882	99.99094	0.009056
4	0.050672	99.99247	0.007532
5	0.053869	99.98327	0.016735
6	0.056659	99.95201	0.047989
7	0.059505	99.89421	0.105793
8	0.062448	99.82576	0.174243
9	0.065290	99.75014	0.249858
10	0.067908	99.66339	0.336610

Variance			
Decomposition of			
LNPSC:			
Period	S.E	LNMS	LNPSC
1	0.023842	4.558150	95.44185
2	0.034697	2.398603	97.60140
3	0.044754	1.562671	98.43733
4	0.054528	1.429595	98.57041
5	0.062084	1.873435	98.12656
6	0.068972	2.039608	97.96039
7	0.075157	2.086176	97.91382
8	0.080765	2.106042	97.89396
9	0.086149	2.114583	97.88542
10	0.091290	2.167621	97.83238

Table-12. Vector Error Correction Estimate

Vector Error Correction Estimates		
Date: 04/15/20 Time: 14:51		
Sample (adjusted): 1999M06 2019M12		
Included observations: 247 after adjustments		
Standard errors in ( ) & t-statistics in [ ]		
Cointegration Eq:	CointEq1	
LNMS(-1)	1.000000	
LNPSC(-1)	-0.772024	
	(0.05021)	
	[-15.3758]	
C	-2.559272	
Error Correction:	D(LNMS)	D(LNPSC)
CointEq1	-0.017068	-0.015388
	(0.00546)	(0.00506)
	[-3.12806]	[-3.04369]
D(LNMS(-1))	0.062603	-0.131271
	(0.06567)	(0.06085)
	[0.95331]	[-2.15740]
D(LNMS(-2))	0.015500	-0.119786
	(0.06536)	(0.06056)
	[0.23713]	[-1.97781]
D(LNMS(-3))	-0.196003	-0.040641
	(0.06582)	(0.06099)
	[-2.97767]	[-0.66634]
D(LNMS(-4))	-0.094108	-0.038757
	(0.06676)	(0.06186)
	[-1.40961]	[-0.62653]
D(LNPSC(-1))	-0.017654	0.067859
	(0.07173)	(0.06646)
	[-0.24611]	[1.02100]

D(LNPSC(-2))	-0.026342	0.113128
	(0.07173)	(0.06647)
	[-0.36722]	[1.70201]
D(LNPSC(-3))	0.005026	0.082894
	(0.07135)	(0.06611)
	[0.07044]	[1.25391]
D(LNPSC(-4))	0.011403	-0.122031
	(0.07074)	(0.06555)
	[0.16120]	[-1.86168]
C	0.027232	0.026171
	(0.00411)	(0.00381)
	[6.62702]	[6.87340]

R-squared	0.089773	0.113034
Adj. R-squared	0.055207	0.079352
Sum sq. resids	0.156915	0.134719
S.E. equation	0.025731	0.023842
F-statistic	2.597174	3.355885
Log likelihood	558.6603	577.4956
Akaike AIC	-4.442593	-4.595106
Schwarz SC	-4.300513	-4.453025
Mean dependent	0.022028	0.022082
S.D. dependent	0.026472	0.024848
Determinant resid covariance (dof adj.)		3.59E-07
Determinant resid covariance		3.31E-07
Log likelihood		1141.917
Akaike information criterion		-9.068158
Schwarz criterion		-8.755581

4. Discussion

Using a VEC model and Granger causality techniques, the study analysed interaction between money supply and private sector credit in Ghana. This study made use of monthly dataset spanning January 1999 to December 2019 of credit to the private sector (PSC) and broad money supply (M2). After assessing stationarity of M2 and PSC and accompanying sequence of econometrics test, both M2 and PSC are stationary based on Augmented Dickey-Fuller (ADF) test.

The results reveal that there exists a long run stationary relation between money supply and private sector credit. Also private sector credit is positively and significantly associated with money supply in the long run. These findings are same as that of Olweny and Chiluwe (2012). This implies, increases in credit should prompt long-term increases in money supply. It is not surprising that growth in the private sector might have a stronger effect on the money supply, in line with Rasheed (2011).

An error correction framework is constructed to model dynamic response that indicates the speed of adjustment from the short-run to the long-run equilibrium state. The ECT is statistically significant and that all the variables demonstrate similar adjustment speeds. This implies that in the short run, both money supply and credit are somewhat equally responsive to their last period's equilibrium error. Impulse response function and variance decomposition under VAR indicated that there is a positive relation between the two variables and they are statistically significant in the short run. This is consistent with the study done by Obeng-Amponsah *et al.* (2019).

The degree of association between the two in the long run is very low. There is unidirectional causation from private sector credit to money supply. This result is similar to a study by Okafor *et al.* (2016), the main findings revealed a one-directional causal relationship running from the private sector credit and broad money supply to economic growth. Another study by Ananzeh (2016) showed unidirectional causality between economic growth and bank credit

5. Conclusion

By confirming a statistically significant positive relationship between money supply and private sector credit, this results support the theoretical assumption private sector is the engine of growth of the economy. Thus, credit to private sector holds great potential in promoting economic growth. It can be recommended to the government to increase the credit flow to the private sector because of its strategic importance in creating and generating growth of the economy.

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Disclosure Statement

The authors declare no competing interests

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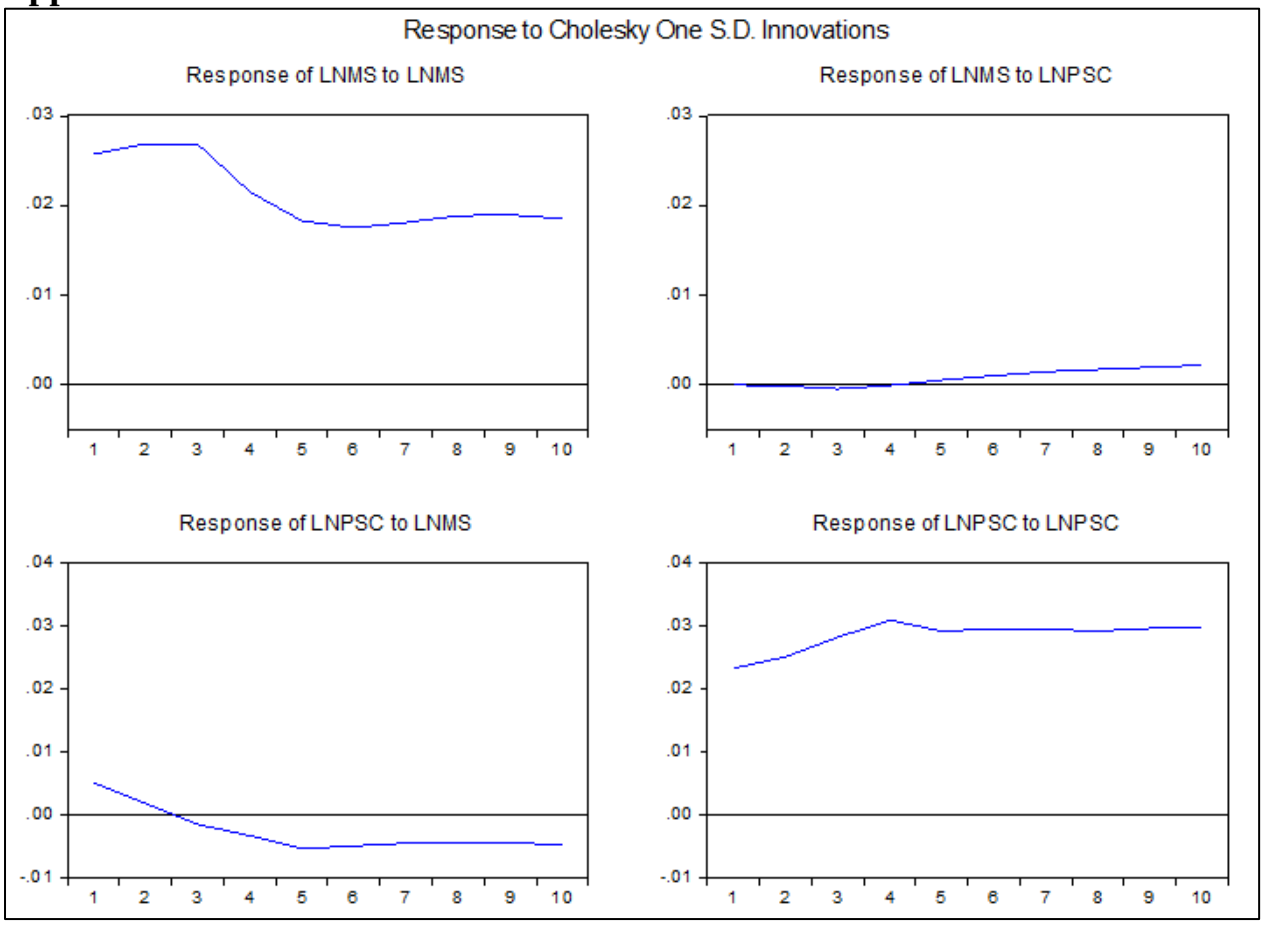
Appendix 1


Response to Cholesky One S.D. Innovations
Response of LNMS to LNMS
Response of LNMS to LNPSC
Response of LNPSC to LNMS
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