Fighting consumer price inflation in Africa. What do dynamics in money, credit, efficiency and size tell us?

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Abstract

Purpose – The purpose of this paper is to examine the effects of policy options in financial dynamics (of money, credit, efficiency and size) on consumer prices. Soaring food prices have marked the geopolitical landscape of African countries in the past decade.

Design/methodology/approach – We limit our sample to a panel of African countries for which inflation is non-stationary. VAR models from both error correction and Granger causality perspectives are applied. Analyses of dynamic shocks and responses are also covered. Six batteries of robustness checks are applied to ensure consistency in the results.

Findings – (1) There are significant long-run equilibriums between inflation and each financial dynamic. (2) When there is a disequilibrium, while only financial depth and financial size could be significantly used to exert deflationary pressures, inflation is significant in adjusting all financial dynamics. In other words, financial depth and financial size are more significant instruments in fighting inflation than financial efficiency and activity. (3) The financial intermediary dynamic of size appears to be more instrumental in exerting a deflationary tendency than financial intermediary depth. (4) The deflationary tendency from money supply is double that based on liquid liabilities.

Practical implications – Monetary policy aimed at fighting inflation only based on bank deposits may not be very effective until other informal and semi-formal financial sectors are taken into account. It could be inferred that, tight monetary policy targeting the ability of banks to grant credit (in relation to central bank credits) is more effective in tackling consumer price inflation than that, targeting the ability of banks to receive deposits. In the same vein, adjusting the lending rate could be more effective than adjusting the deposit rate. The insignificance of financial allocation efficiency and financial activity as policy tools in the battle against inflation could be explained by the (well documented) surplus liquidity issues experienced by the African banking sector.

Social implications – This paper helps in providing monetary policy options in the fight against soaring consumer prices. By keeping inflationary pressures on food prices in check, sustained campaigns involving strikes, demonstrations, marches, rallies and political crises that seriously disrupt economic performance could be mitigated.

Originality/value – As far as we have perused, there is yet no study that assesses monetary policy options that could be relevant in addressing the dramatic surge in the price of consumer commodities.

Keywords : Banks; Inflation; Development; Panel; Africa
JEL Classification: E31; G20; O10; O55; P50

1. Introduction

During the past decade, the world has seen a dramatic rise in the price of many staple food commodities. For instance, the price of maize increased by 80% between 2005-2007 and has since increased further. Many other commodity prices have also soared sharply over this period: milk powder by 90%, rice by 25% and wheat by 70%. Such large variations in prices have had tremendous impacts on the incomes of poor households in developing countries (FAO, 2007; World Bank 2008; Ivanic & Martin, 2008). Assessing how to fight inflation is particularly relevant given its positive incidence on poverty (Fujii, 2011), especially in a continent where poverty has remained stubbornly high despite financial reforms and structural adjustment policies (Asongu, 2012a). Also, while low inflation may mitigate inequality (Bulir, 1998; Lopez, 2004), high inflation has been documented to have a negative income redistributive effect (Albanesi, 2007) in recent African inequality literature (Asongu, 2012a).

The overall effect on poverty rates in African countries is contingent on whether the gains to poor net producers outweigh the adverse impact on poor consumers. The bearing of food prices on the situation of particular households also depends importantly on the products involved, the patterns of households income and expenditure, as well as policy responses of governments. On account of existing analyses, the impacts of higher food prices on poverty and inequality are likely to be very diverse; depending on the reasons for the price change and the structure of the economy (Ravallion & Lokhsin, 2005; Hertel & Winters, 2006). While the effects of soaring food prices on inequality and poverty may depend on certain circumstances, most analysts agree that, sustained increased in food prices ultimately leads to sociopolitical unrests like those experienced in 2008.

The World Bank has also raised concerns over the impact of high prices on socio-political stability (World Bank, 2008). Most studies confirm the link between rising food prices and the recent waves of revolutions that have marked the geopolitical landscape of developing countries over the last couple of months (World Bank, 2008; Wodon & Zaman, 2010). The premises of the Arab Spring and hitherto unanswered questions about some of its dynamics could be traced to poverty; owing to unemployment and rising food prices. "*We will take to the streets in demonstrations or we will steal,*" a 30-year old Egyptian woman in 2008 vented her anger as she stood outside a bakery. Riots and demonstrations linked to soaring consumer prices took place in over 30 countries between 2007-08. The Middle East encountered food riots in Egypt, Jordan, Morocco and Yemen. In Ivory Coast, thousands marched to the home of President then Laurent Gbagbo chanting: "*you are going to kill us*"," *we are hungry*", "*life is too expensive*" …etc. Similar demonstrations followed in many other African countries, including , Cameroon, Senegal, Ethiopia, Burkina Faso, Mozambique, Mauritania and Guinea. In Latin America, violent clashes and demonstrations over rising food prices occurred in Guatemala, Peru, Nicaragua, Bolivia, Argentina, Mexico and the Haitian prime minister was even toppled following food riots. In Asia, people flooded the streets in Bangladesh, Cambodia, Thailand, India and the Philippines. Even North Korea surprisingly experienced an incident in which market women gathered to protest against restrictions on their ability to trade in food (Hendrix et al., 2009). The geopolitical landscape in the last couple of months has also revolved around the inability of some political regimes to implement concrete policies that ensure the livelihoods of their citizens. Tunisia, Egypt, Morocco, Senegal, Uganda, Zambia, Mauritania, Sudan, Western Sahara and most recently Nigeria are some countries that have witnessed major or minor unrests via techniques of civil resistance in sustained campaigns involving strikes, demonstrations, marches and rallies.

Whereas the literature on the causes and impacts of the crisis in global food prices in the developing world has mushroomed in recent years (Piesse & Thirtle, 2009; Wodon & Zaman, 2010; Masters & Shively, 2008), we are unaware of studies that have closely examined how financial policies affected consumer prices. Remedial policy and pragmatic choices aimed at fighting inflation that have been documented include both short and medium term responses (SIFSIA, 2011). Short-term and immediate measures include: input vouchers and input trade fairs (seeds, fertilizer and tools) for vulnerable farmers; reinforcement of capacity (training and equipment) in income generating activities; safety-nets (cash transfers or food vouchers); tax measures and government policies. Medium term measures could be clubbed into three strands: trade and market measures; production and productivity incentives; coordination and activation of food security plan. Firstly, trade and market measures include: reduction of import taxes on basic food items and grain-export bans when needed; strengthening the food and agricultural market information system; conducting of value chain analysis; building of efficient marketing institutions; facilitation of farming contract arrangements; lowering of distribution cost; strategic reserve support and government anticipation of price increase. Secondly, production and productivity incentives include: investing in agriculture; addressing of poor harvest and promotion of shelf-life products. Thirdly, coordination and activation of food security action plan involve: coordination and coherence among various agencies engaged in price stabilization efforts; comprehensiveness of multi-sectoral responses to price hikes and coordination (synchronization) of food insecurity plan, in a bid to achieve the maximum impact.

According to Von Braun (2008), monetary and exchange rate policy responses were not effective in addressing food inflation. This revelation by the Director General of the International Food Policy Research Institute has motivated us to peruse the literature in search of monetary policies on soaring food prices. Finding none, the present paper fills this gap in the literature by assessing how financial development dynamics in money, credit, activity, efficiency and size could be exploited in monetary policy to keep food prices in check. In plainer terms, this work aims to assess the impact of the following dynamics on food prices. (1) Money: the role of financial depth (in dynamics of overall economic money supply and financial system liquid liabilities). (2) Credit: the incidence of financial activity dynamics (in banking and financial system perspectives). (3) Efficiency: the impact of financial intermediary allocation efficiency (from banking and financial system angles). (4) Size: the part financial size plays. Another appeal of this paper is the scarcity of literature on the effect of financial development on inflation despite a substantial body of work on the economic and financial consequences of inflation (Barro, 1995; Bruno & Easterly, 1998; Bullard & Keating, 1995; DeGregorio, 1992; Boyd et al., 2001).

The rest of the paper is organized as follows. Section 2 presents data and discusses the methodology. Empirical analysis is outlined in Section 3. Discussion and policy implications are covered in Section 4. Section 5 concludes.

2. Data and Methodology

2.1 Data

We examine a panel of 10 African countries with data from the Financial Development and Structure Database (FDSD) and African Development Indicators (ADI) of the World Bank (WB). The ensuing balanced panel is restricted from 1980 to 2010 owing to constraints in data availability. Information on summary statistics and correlation analysis is detailed in Appendix 1 and Appendix 3 respectively. Definition of the variables and corresponding sources are presented in Appendix 2. Countries in the sample include: Algeria, Egypt, Lesotho, Morocco, Nigeria, Sudan, Tunisia, Uganda[1], Zambia and Tanzania[2]. The limitation to these countries is primarily based on the inability of some African countries to exhibit a unit root in consumer price inflation. Given the problem statement of the study, it is interesting to have non-stationary consumer price inflation for consistent modeling. Hence, in accordance with recent African law-finance literature (Asongu, 2011a), CFA franc [3] countries of the CEMAC[4] and UEMOA[5] zones have not been included[6]. Beside the justifications for eliminating CFA franc countries provided by preliminary analysis and recent theoretical postulations (Asongu, 2011a), the seminal work of Mundell (1972) has shown that, African countries with flexible exchange rates regimes have more to experience in the fight against inflation than their counterparts with fixed exchange rate regimes[7].

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[1]"*Despite decelerating to 27.0 percent in December 2011 from a high of 30.4 percent in October, inflation in Uganda is still far higher than expected, given the 3 percent rate at the end of 2010. Year-on-year food inflation spiked to 45.6 percent in October 2011, while non-food inflation has been increasing steadily, moving to 22.8 percent from 5.5 percent in December 2010*" (Simpasa et al., 2011, p. 3).

[2] "*Tanzania inflation reached 19.8 percent in December 2011, well above the 10 percent average for the last few years. However, in 2010, inflationary pressures started to build, fuelled by soaring food and energy prices, while the government's fiscal outlays added to the inflationary pressure. Since October 2010, inflation has more than tripled, reaching 17.9 percent in October 2011. Although food inflation has slowed recently, it is unlikely to offset other inflationary pressures* " (Simpasa et al., 2011, p. 3).

[3]The CFA franc is the name of two currencies used in Africa (by some former French colonies) which are guaranteed by the French treasury. The two CFA franc currencies are the West African CFA franc (used in the UEMOA zone) and Central African CFA franc (used in the CEMAC zone). The two currencies though theoretically separate are effectively interchangeable.

[4] Economic and Monetary Community of Central African States.

[5] Economic and Monetary Community of West African States.

[6] The need for inflation to exhibit a unit root in order to accommodate the problem statement draws from an' inflation uncertainty' theory in recent African finance literature. "*The dominance of English common–law countries in prospects for financial development in the legal–origins debate has been debunked by recent findings. Using exchange rate regimes and economic/monetary integration oriented hypotheses, this paper proposes an 'inflation uncertainty theory' in providing theoretical justification and empirical validity as to why French civil–law countries have higher levels of financial allocation efficiency. Inflation uncertainty, typical of floating exchange rate regimes accounts for the allocation inefficiency of financial intermediary institutions in English common–law countries. As a policy implication, results support the benefits of fixed exchange rate regimes in financial intermediary allocation efficiency"* Asongu (2011a, p.1). Also, before restricting the dataset, we have found from preliminary analysis that, African CFA franc countries have a relatively very stable inflation rate.

[7] "*The French and English traditions in monetary theory and history have been different… The French tradition has*

In line with the literature (Bordo & Jeanne, 2002; Hendrix et al., 2009) and the problem statement, the dependent variable is measured in terms of annual percentage change in the Consumer Price Index (CPI). For clarity in organization, the independent variables are presented in terms of depth, efficiency, activity and size.

Firstly, from a financial intermediary depth standpoint, we are consistent with the FDSD and recent African finance literature (Asongu, 2011bcd) in measuring financial depth both from overall-economic and financial system perspectives with indicators of broad money supply (*M2/GDP*) and financial system deposits (*Fdgdp*) respectively. Whereas the former represents the monetary base plus demand, saving and time deposits, the latter denotes liquid liabilities of the financial system. Since we are dealing exclusively with developing countries, we distinguish liquid liabilities from money supply because a great chunk of the monetary base does not transit via the banking sector (Asongu, 2011e). The two indicators are in ratios of GDP (see Appendix 2) and can robustly check one another as either account for over 98% of information in the other (see Appendix 3).

Secondly, by financial efficiency[8] here, we neither refer to the profitability-related concept nor to the production efficiency of decision making units in the financial sector (through Data Envelopment Analysis: DEA). What the paper aims to elucidate is the ability of banks to effectively fulfill their fundamental role of transforming mobilized deposits into credit for

stressed the passive nature of monetary policy and the importance of exchange stability with convertibility; stability has been achieved at the expense of institutional development and monetary experience. The British countries by opting for monetary independence have sacrificed stability, but gained monetary experience and better developed monetary institutions." (Mundell, 1972, pp. 42-43).

[8] "*It is widely acknowledged that money growth must be seen as more dangerous for price stability when accompanied by strong credit. On the contrary, robust money growth not associated with sustained credit expansion and strong dynamics in asset prices seems to be less likely to have inflationary consequences*".(Anonymous Referee). This is consistent with a recent strand of empirical literature (Bordo & Jeanne, 2002; Borio & Lowe, 2002; Borio and Lowe, 2004; Detken & Smets, 2004; Van den Noord, 2006; Roffia & Zaghini, 2008; Bhaduri & Durai, 2012). These comment and fact have been incorporated into the analysis from an efficiency standpoint. Financial intermediary allocation efficiency reflects how money growth (through bank deposits) is accompanied by credit facilities.

economic operators. We adopt indicators of banking-system-efficiency and financial-system-efficiency (respectively 'bank credit on bank deposits: *Bcbd'* and 'financial system credit on financial system deposits: *Fcfd'*). As with financial depth dynamics, these two financial allocation efficiency proxies can check each other as either represent more than 95% of variability in the other (see Appendix 3).

Thirdly, in accordance with the FDSD, we proxy for financial intermediary development size as the ratio of "deposit bank assets" to "total assets" (deposit bank assets on central bank assets plus deposit bank assets: *Dbacba*).

Fourthly, by financial intermediary activity, the paper points out the ability of banks to grant credit to economic operators. We appreciate both bank-sector-activity and financial-sector-activity with "private domestic credit by deposit banks: *Pcrb*" and "private credit by domestic banks and other financial institutions: *Pcrbof*" respectively. The former measure checks the latter as it represents more than 98% of information in the latter (see Appendix 3).

2.2 Methodology

The estimation technique typically follows mainstream literature on fighting inflation (Bernanke & Gertler, 1995; Detken & Smets, 2004; Goujon, 2006). The estimation approach entails the following steps: unit root tests, cointegration tests, vector error correction estimation, Granger causality modeling and impulse-response analysis. Robustness checks are ensured by: (1) the use of alternative financial indicators; (2) consideration of homogenous and heterogeneous assumptions in both unit root and cointegration tests; (3) optimal lag selection for goodness of fit in model specification consistent with the recommendations of Liew (2004); (4) usage of bivariate analysis to limit causality misspecification issues; (5) application of vector error correction and simple Granger causality and; (6) verifying that, the signs and intervals of the error correction terms are consistent with theory.

3. Empirical Analysis

3.1 Unit root tests

We begin by testing for serial correlations with two types of panel unit root tests. When the variables are not stationary in level, we proceed to test for stationarity in first difference. While short-run Granger causality presupposes the absence of unit roots, the Vector Error Correction Model (VECM) requires that the variables have a unit root (non stationary) in level (series). There are two main types of panel unit root tests: first generational (that assumes cross sectional independence); and second generational (based on cross sectional dependence). A precondition for the application of the latter is a cross sectional dependence test which is possible only and only if the number of cross sections (N) in a panel exceed the number of periods in the cross-sections (T). Hence, we focus on the first generational type. To this end, both the Levin, Lin & Chu (LLC, 2002) and Im, Pesaran & Shin (IPS, 2003) tests are applied. Whereas the former is a homogenous based panel unit root test (common unit as null hypothesis), the latter is a heterogeneous oriented test (individual unit roots as null hypotheses). In case of conflict of interest in the results, IPS (2003) takes precedence over LLC (2002) in decision making because, according to Maddala & Wu (1999), the alternative hypothesis of LLC (2002) is too powerful. Consistent with Liew (2004), goodness of fit is ensured by the Hannan-Quinn Information Criterion (HQC) and the Akaike Information Criterion (AIC) for the LLC (2002) and IPS (2003) tests respectively[9].

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[9] *"The major findings in the current simulation study are previewed as follows. First, these criteria managed to pick up the correct lag length at least half of the time in small sample. Second, this performance increases substantially as sample size grows. Third, with relatively large sample (120 or more observations), HQC is found to outdo the*

Table 1: Panel unit root tests

Deterministic components		LLC tests for homogenous panel				IPS tests for heterogeneous panel			
		Panel A: Financial Depth and Efficiency							
		Financial Depth		Financial Efficiency		Financial Depth		Financial Efficiency	
		M2	Fdgdp	BcBd	FcFd	M2	Fdgdp	BcBd	FcFd
Level	c	3.396	2.616	0.346	0.055	2.926	2.764	0.088	-0.011
	ct	3.138	3.820	0.701	2.230	3.131	3.870	1.136	1.466
First difference	c	**-2.255****	**-1.328***	1.096	0.861	**-3.73*****	**-2.115****	**-3.24*****	**-1.357***
	ct	**-1.916****	-0.415	2.637	1.796	**-2.032****	**-1.367***	**-2.026****	-0.924
		Panel B: Financial Activity, Financial size and Inflation							
		Financial Activity		Fin. Size	Inflation	Financial Activity		Fin. Size	Inflation
		Pcrb	Pcrbof	Dbacba	Infl.	Pcrb	Pcrbof	Dbacba	Infl.
Level	c	1.519	1.057	2.175	-0.271	3.099	2.279	2.454	0.694
	ct	2.887	2.644	0.307	0.264	3.266	2.963	0.494	0.833
First difference	c	0.431	-0.167	**-2.042****	3.142	**-1.367***	**-1.897****	**-4.83*****	**-5.55*****
	ct	**-3.26*****	**-3.58*****	7.004	6.848	-1.223	**-1.947****	**-2.38*****	**-3.69*****

Notes: *, **, *** denote significance at 10%, 5% and 1% respectively. 'c' and 'ct': 'constant' and 'constant and trend' respectively. Maximum lag is 8 and optimal lags are chosen via HQC for LLC test and AIC for IPS test. Optimal lag for the most part is 2. LLC: Levin, Lin & Chu (2002). IPS: Im, Pesaran & Shin (2003). M2: Money Supply. Fdgdp: Liquid Liabilities. BcBd: Banking System Efficiency. FcFd: Financial System Efficiency. Pcrb: Banking System Activity. Pcrbof: Financial System Activity. Dabcba: Financial Size. Infl: Inflation. Fin: Financial.

Table 1 above reports the panel unit root tests results. It can be observed that, all the variables exhibit a unit root in level; that is, they are non-stationary. However, on account of the IPS (2003) results, the variables are overwhelmingly stationary in first difference. These findings indicate the possibility of a long-run equilibrium (cointegration) among variables; because according to Engel-Granger theorem, two variables that are not stationary may have a linear combination in the long-run (Engle & Granger, 1987).

3.2 Cointegration tests

According to the cointegration theory, two or more series that have a unit root may have a linear combination (equilibrium) in a long-run. In this equilibrium, permanent movements of one factor (variable) affect permanent movements in the other factor.

rest in correctly identifying the true lag length. In contrast, AIC and FPE should be a better choice for smaller sample. Fourth, AIC and FPE are found to produce the least probability of under estimation among all criteria under study. Finally, the problem of over estimation, however, is negligible in all cases. The findings in this simulation study, besides providing formal groundwork supportive of the popular choice of AIC in previous empirical researches, may as well serve as useful guiding principles for future economic researches in the determination of autoregressive lag length"(Liew, 2004, p. 2).

Table 2: Bivariate panel cointegration tests (Pedroni and Kao Engle-Granger based tests)

	Panel A: Depth, Efficiency and Inflation							
	Financial Depth and Inflation				Financial Efficiency and Inflation			
	M2 and Inflation		Fdgdp and Inflation		BcBd and Inflation		FcFd and Inflation	
	c	ct	c	ct	c	ct	c	ct
	Engle-Granger based Pedroni test for heterogeneous panel							
Panel v-Statistics	-0.484	-1.598	-0.712	-2.066	-0.861	-2.447	-1.160	-2.871
Panel rho-Statistics	**-1.445***	**-1.686****	**-1.677****	**-1.630***	**-2.84*****	**-2.95*****	**-2.622*****	**-1.896****
Panel PP-Statistics	**-1.828****	**-3.702*****	**-2.083****	**-3.47*****	**-3.10*****	**-4.27*****	**-3.193*****	**-3.76*****
Panel ADF-Statistics	-0.721	**-1.526***	-1.131	**-1.681****	-1.07	**-1.68****	-0.626	0.111
Group rho-Statistics	-0.373	-0.340	-0.797	-0.287	**-1.67****	**-1.525***	-1.208	-0.742
Group PP-Statistics	**-1.534***	**-4.029*****	**-2.362*****	**-4.33*****	**-1.911****	**-2.66*****	**-2.75*****	**-6.47*****
Group ADF-Statistics	-0.300	**-1.988****	**-1.313***	**-2.291****	0.041	0.183	0.247	0.508
	Engle-Granger based Kao test for homogenous panel							
-ADF t statistics	0.036	n.a	-0.592	n.a	-0.696	n.a	**-1.752****	n.a

	Panel B: Activity, Size and Inflation					
	Financial Activity and Inflation				Financial Size and Inflation	
	Pcrb and Inflation		Pcrbof and Inflation		Dbacba and Inflation	
	c	ct	c	ct	c	ct
	Engle-Granger based Pedroni test for heterogeneous panel					
Panel v-Statistics	-0.885	-2.608	-0.639	-2.377	0.330	-1.653
Panel rho-Statistics	**-2.44*****	**-2.12****	**-2.719*****	**-2.097****	**-2.97*****	**-1.964****
Panel PP-Statistics	**-2.71*****	**-3.69*****	**-2.949*****	**-3.72*****	**-3.03*****	**-3.17*****
Panel ADF-Statistics	0.202	0.795	-0.399	-0.074	**-3.10*****	**-2.154****
Group rho-Statistics	-1.120	-0.561	**-1.764****	**-1.375***	**-2.038****	-1.187
Group PP-Statistics	**-2.60*****	**-4.51*****	**-3.215*****	**-5.60*****	**-2.191****	**-2.358*****
Group ADF-Statistics	0.703	0.697	-0.140	-0.587	-0.439	-0.216
	Engle-Granger based Kao test for homogenous panel					
	-0.317	n.a	-0.069	n.a	-0.389	n.a

Notes: *, **, *** denote significance at 10%, 5% and 1% respectively. 'c' and 'ct': 'constant' and 'constant and trend' respectively. M2: Money Supply. Fdgdp: Liquid Liabilities. BcBd: Banking System Efficiency. FcFd: Financial System Efficiency. Pcrb: Banking System Activity. Pcrbof: Financial System Activity. Dabcba: Financial Size. PP: Phillips-Peron. ADF: Augmented Dickey Fuller. No deterministic trend assumption. Maximum lags is 8 and optimal lags are chosen via AIC. Optimal lags for the most part is 1, with exceptions of tests for financial system efficiency and financial system activity where 3 and 2 lags are used respectively.

To investigate this long-run relationship, we test for cointegration using Engle-Granger based Pedroni and Engle-Granger Kao tests. Consistent with Camarero & Tamarit (2002), the advantage of applying these two tests is that, while the former (Pedroni; 1999) is heterogeneous, the latter (Kao; 1999) is homogenous based. Implementation of both tests is in line with our earlier application of both homogenous (LLC) and heterogeneous (IPS) unit root tests. Similar deterministic trend components used in unit root tests are applied. However, the Pedroni (1999) test will be given priority in event of conflict of interest because, it has more deterministic components[10]. Optimal lag selection for goodness of fit is by the AIC. The choice of bivariate statistics instead of multivariate statistics is to avoid misspecification in causality estimations[11].

Table 2 above reports results of the cointegration tests. While Panel A reports the long-term relationship between financial depth (efficiency) and inflation, Panel B reveals findings for the long-run equilibrium between financial activity (size) and inflation. It could be observed from the Engle-Granger based Pedroni test that, there is overwhelming evidence of a long-term relationship between each financial dynamic and inflation. It follows that in the long-run, permanent changes in each financial dynamic affect permanent changes in inflation. Hence, the need to investigate short-term adjustments to this long-run equilibrium with the VECM.

3.3 Vector Error Correction Model (VECM)

Let us consider inflation and a financial dynamic with no lagged difference, such that:

$$Inflation_{i,t} = \beta Finance_{i,t} \quad (1)$$

The resulting VECMs are the following:

$$\Delta Inflation_{i,t} = \partial (Inflation_{i,t-1} - \beta Finance_{i,t-1}) + \varepsilon_{1,t} \quad (2)$$

$$\Delta Finance_{i,t} = \sigma (Finance_{i,t-1} - \beta Inflation_{i,t-1}) + \varepsilon_{2,t} \quad (3)$$

In Eq. (1) and Eq. (2), the right hand terms are the Error Correction Terms (ECTs). At equilibrium, the value of the ECT is zero. When the ETC is non-zero, it implies that inflation and a financial dynamic have deviated from the long-run equilibrium; and the ECT helps each variable to adjust and partially restore the equilibrium. The speeds of these adjustments are measured by ∂ and σ for inflation and a given financial dynamic respectively. Hence, Eqs. (1) and (2) are replicated for each 'financial dynamic and inflation' pair. The same deterministic

[10] Pedroni (1999) is applied in the presence of both 'constant' and 'constant and trend' while Kao (1999) is based only on the former (constant).
[11] For example, multivariate cointegration may involve variables that are stationary in levels (See Gries et al., 2009).

trend assumptions used in the cointegration tests are applied and optimal lag selection for goodness of fit in model specification is in line with the AIC (Liew, 2004).

Based on results reported in Table 3, while only financial depth and financial size are exogenous to deflationary pressures, inflation is exogenous to all financial intermediary dynamics under consideration. In other words, when there is a disequilibrium, while only financial depth and financial size could be significantly used to exert inflationary pressures, inflation is significant in adjusting all financial dynamics. Panel A and Panel B are based on Eqs. (2) and (3) respectively. The ECTs have the expected signs and are in the right interval (See Section 3.5 on robustness checks for discussion below). In event of a shock, short-run adjustments of finance to the equilibrium (Panel B) are faster than short-term adjustments of inflation (Panel A). Hence, finance is more endogenous to inflation than finance is exogenous to inflation. Since some models (financial efficiency and activity in Panel A for the most part) are cointegrated with inflation but have no significant corresponding short-term adjustments to long-run equilibrium, we proceed to analyze the relationship of the variables under consideration by simple Granger causality.

3.4 Granger Causality

Considering a basic bivariate finite-order VAR model, simple Granger causality is based on the assessment of how past values of a financial dynamic could help past values of inflation in explaining the present value of inflation. In mainstream literature, this model is applied on variables that are not cointegrated (that is, pairs that are stationary in levels). However, within our framework we are applying this test to all pairs in 'first difference' for two reasons: ensure comparability and; the model can be applied only when variables are stationary and ours are stationary only in 'first difference'. In light of the above, the resulting VAR models are the following:

$$\Delta Inflation_{i,t} = \sum_{j=1}^{p} \lambda_{ij} \Delta Inflation_{i,t-j} + \sum_{j=0}^{q} \delta_{ij} \Delta Finance_{i,t-j} + \mu_i + \varepsilon_{i,t} \quad \ldots\ldots..(4)$$

$$\Delta Finance_{i,t} = \sum_{j=1}^{p} \lambda_{ij} \Delta Finance_{i,t-j} + \sum_{j=0}^{q} \delta_{ij} \Delta Inflation_{i,t-j} + \mu_i + \varepsilon_{i,t} \quad \ldots\ldots\ldots(5)$$

The null hypothesis of Eq. (4) is the position that, *Finance* does not Granger cause *Inflation*. Hence, a rejection of the null hypothesis is captured by the significant F-statistics; which is the Wald statistics for the joint hypothesis that estimated parameters of lagged values equal zero. Optimal lag selection for goodness of fit is in accordance with the AIC (Liew, 2004). Based on the results reported in Table 3 below, while financial size causes inflation, the latter causes financial depth (money supply and liquidity liabilities).

Table 3: Vector Error Correction Model and Granger Causality estimations

		Panel A: Deflationary Adjustments (Finance effects on Inflation)						
		Financial Depth		Fin. Efficiency		Financial Activity		Fin. Size
		M2	Fdgdp	BcBd	FcFd	Pcrb	Pcrbof	Dbacba
VECM	ECT	**-0.0002*** **	**-0.0001***	-0.0001	-0.000	-0.000	-0.000	**-0.0006*** **
	(t-statistics)	**(-2.563)**	**(-1.971)**	(-0.388)	(-0.612)	(-0.843)	(-1.023)	**(-2.072)**
Granger Causality	Short-run F-stats	1.710	0.816	1.372	2.239	0.625	0.516	**3.405*** **
		Panel B: Financial Adjustments (Inflation effects on Finance)						
		Financial Depth		Fin. Efficiency		Financial Activity		Fin. Size
		M2	Fdgdp	BcBd	FcFd	Pcrb	Pcrbof	Dbacba
VECM	ECT	**-0.213*** **	**-0.208*** **	**-0.163*** **	**-0.187*** **	**-0.205*** **	**-0.204*** **	**-0.158*** **
	(t-statistics)	**(-4.945)**	**(-4.865)**	**(-3.811)**	**(-4.736)**	**(-4.781)**	**(-4.851)**	**(-2.344)**
Granger Causality	Short-run F-stats	**2.416***	**2.510***	0.355	0.442	1.868	1.584	2.228

Notes: *, **, *** denote significance at 10%, 5% and 1% respectively. 'c' and 'ct': 'constant' and 'constant and trend' respectively. M2: Money Supply. Fdgdp: Liquid Liabilities. BcBd: Banking System Efficiency. FcFd: Financial System Efficiency. Pcrb: Banking System Activity. Pcrbof: Financial System Activity. Dabcba: Financial Size. VECM: Vector Error Correction Model. ECT: Error Correction Term. The deterministic trend assumptions and lag selection criteria for the VECM are the same as in the cointegration tests (No deterministic trend assumption. Maximum lag is 8 and optimal lags are chosen via the AIC. Optimal lags for the most part is 1, with exceptions of analyses for financial system efficiency and financial system activity in which 3 and 2 lags are used respectively). For Granger causality, the optimal lag selection is based on the AIC. F(t): Fisher (student) statistics. Fin: Financial.

3.5 Robustness checks

In order to ensure that our results are robust, we have performed the following. (1) With the exception of financial size, (for every financial dynamic) two indicators have been employed. Hence, the findings have encapsulated measures of financial intermediary performance both from banking and financial system perspectives. (2) Both homogenous and heterogeneous assumptions are applied in the unit root and cointegration tests. (3) Optimal lag selection for goodness of fit in model specifications is in line with the recommendations of Liew (2004). (4) By using bivariate analysis in cointegration tests and corresponding VECM estimations, we have limited causality misspecification issues. (5) Both VECM and simple Granger VAR specifications for respectively long-run and short-term causality have been applied. (6) The signs and intervals of the ECTs conform to theory.

While the first five points have already been elucidated above, the sixth has only been highlighted. Hence, the need to discuss its relevance to the results. In principle, the speed of adjustment of the parameters should be between zero and 'minus one' (0, -1). If the ECTs are not within this interval, then either the model is misspecified (and needs adjustment) or the data is inadequate (perhaps owing to issues with degrees of freedom)[12].

4. Dynamic responses to shocks and policy implications

4. 1 Dynamic responses

Using a Choleski decomposition on a VAR with ordering: 1) inflation, 2) a financial dynamic; we compute impulse response functions (IRFs) for inflation and financial dynamics.

[12] "*The error correction term tells us the speed with which our model returns to equilibrium following an exogenous shock. It should be negatively signed, indicating a move back towards equilibrium, a positive sign indicates movement away from equilibrium. The coefficient should lie between 0 and 1, 0 suggesting no adjustment one time period later, 1 indicates full adjustment. The error correction term can be either the difference between the dependent and explanatory variable (lagged once) or the error term (lagged once), they are in effect the same thing*" (Babazadeh & Farrokhnejad, 2012, p.73).

However, given the character of the problem statement in this study, policy implications will be based on the responses of inflation to shocks in financial dynamics. In other words, how one standard deviation in financial dynamic innovations affect inflation. A negative response of inflation to a (positive) shock in a financial dynamic will imply a deflationary tendency in the consumer price index. Hence, an effective shock in the fight against inflation. Appendices 4-10 present graphical representations corresponding to the IRFs.

The dotted lines shown around the IRFs in Appendices 4-10 are the two standard deviation bands, which are used as a measure of significance (Agénor et al., 1997, p. 19). A number of results are noteworthy. Firstly, the results obtained for dynamics of each financial dimension are broadly similar, indicating robustness of our results to the choice of corresponding financial dynamics within each financial dimension[13]. Secondly, shocks in financial dynamics have a significant impact on the temporary component of inflation. Broadly across the IRFs, a decrease in a financial intermediary performance dynamic leads to a (temporary) decrease in inflation (deflation)[14]. This effect is consistent with the theoretical predictions and illustrate the contraction of financial intermediary activities as a measure of fighting inflation. Though all financial adjustments from a VEC framework are significant with the right signs, from a VAR-based IRFs framework, (owing to the problem statement), policy implications will only be based on deflationary adjustments (shocks in financial dynamics of depth and size) because, these have significant adjustment terms from a VECM-based framework (see Panel A of Table 3).

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[13]For example, from a financial depth perspective, the response to a money supply shock is similar to that of a liquid liability shock. In the same vein, the response of a banking efficiency shock is similar to that of a financial efficiency shock. This same analogy applies to financial intermediary activity (from banking and financial system perspectives).

[14]In Appendix 4, a one standard deviation negative shock to money supply sharply decreases inflation within the first year, then slightly decreases it again the next year before a slightly steady inflationary effect after the second year (see response of INFLATION to M2). The deflationary effect in the first year of the shock is consistent with the liquid liabilities perspective of financial depth in Appendix 5. Here again, a one standard deviation negative shock of liquidity liabilities has a deflationary pressure on consumer prices within the first year (see response of INFLATION to FDGDP).

Hence, the following findings have been established. (1) There are significant long-run equilibriums between inflation and each financial dynamic. (2) When there is a disequilibrium, while only financial depth and financial size could be significantly used to exert deflationary pressures, inflation is significant in adjusting all financial dynamics. In other words, financial depth and financial size are more significant instruments in fighting inflation than financial efficiency and activity. (3) The financial intermediary dynamic of size appears to be more instrumental in exerting a deflationary tendency than financial intermediary depth. (4) The deflationary tendency from money supply is double that based on liquid liabilities.

4.2 Policy implications, caveats and future directions

Four main policy implications could be derived from the findings established above. Firstly, the fact that the effectiveness of money supply as an instrumental tool in fighting inflation almost doubles that of liquid liabilities (bank deposits) is consistent with theoretical postulations that, a great chunk of the monetary base in developing countries does not transit through the banking sector. Hence, monetary policy aimed at fighting inflation only based on bank deposits may not be very effective until other informal and semi-formal financial sectors are taken into account. An eloquent example is the growing phenomenon of mobile banking in African countries (that constitute the monetary base but) not captured by mainstream monetary policies based on formal financial activities (Asongu, 2012b). Secondly, financial intermediary size[15] appears to be more effective than financial intermediary dynamics of depth (money supply and bank deposits). In other words, decreasing financial intermediary assets (in relation to central bank assets) more substantially exerts deflationary pressures on consumer prices. It could therefore be inferred that, tight monetary policy targeting the ability of banks to grant credit (in

[15]Financial size as defined by our paper is also in relative terms (bank assets on total assets). Total assets here refer to bank assets plus central bank assets. Bank assets refer to credit granted to economic operators.

relation to central bank credits) is more effective in fighting consumer price inflation, than that targeting the ability of banks to receive deposits. In the same vein, adjusting the lending rate could be more effective than adjusting the deposit rate. Thirdly, we have seen that financial depth and financial size are more significant instruments in fighting inflation than financial efficiency[16] and activity[17]. The deflationary effects of reducing financial allocation efficiency and credit allocation have had the rights signs but not significant. While inherent surplus liquidity issues in African banks could explain the insignificance of the efficiency dimension (Saxegaard, 2006), we expected the inflation-mitigation effect of financial activity to be significant. The insignificant character of financial activity as an effective instrument in fighting inflation may be sample-specific. Hence, the result should not be treated with caution and not generalized to all African countries[18].

To the best of our knowledge, the absence of literature dedicated to examining the bearing of financial dynamics on inflation makes our results less comparable. In this paper, we have only considered financial intermediary determinants of inflation. But in the real world, inflation is endogenous to a complex set of variables: exchange rates, wages, price controls…etc. Thus, the interaction of money, credit, efficiency and size elasticities of inflation with other determinants of inflation could result in other dynamics of consumer price variations.

Hence, it would be interesting to replicate the analysis in a multivariate VAR context. Another interesting future research direction could be to assess whether the findings apply to

[16] Financial allocation efficiency in the context of this paper refers to the probability of deposits being transformed into credit for economic operators. In other words, financial intermediation efficiency is the ability of financial depth to allocate credit for financial activity. Thus financial efficiency is a relative measure (see Beck et al.,1999).

[17] Financial activity in the context of this paper refers to the ability of financial institutions to grant credit to economic operators.

[18]The insignificance of financial allocation efficiency and financial activity as policy tools in the battle against inflation could be explained by the well documented surplus liquidity issues experienced by the African banking sector (Saxegaard, 2006). Thus, allocation inefficiency (due to low transformation of mobilized funds into credit) and slow financial activity (limited granting of credit to economic operators) could partly elucidate this finding.

other developing countries. Also, since a substantial chunk of the monetary base is now captured by the burgeoning phenomenon of mobile banking, investigating how mobile-banking oriented inflation could be managed is a particularly relevant future research focus.

5. Conclusion

In recent years, the African geopolitical landscape has been marked with political strife and social unrests due to increases in consumer prices. This paper had assessed how financial intermediary development dynamics could be exploited in monetary policy to keep food prices in check. We have investigated the impact by examining the roles of money, credit, efficiency and financial size on inflationary pressures. Four main findings have been established. (1) There are significant long-run equilibriums between inflation and each financial dynamic. (2) When there is a disequilibrium, while only financial depth and financial size could be significantly used to exert deflationary pressures, inflation is significant in adjusting all financial dynamics. In other words, financial depth and financial size are more significant instruments in fighting inflation than financial efficiency and activity. (3) The financial intermediary dynamic of size appears to be more instrumental in exerting a deflationary tendency than financial intermediary depth. (4) The deflationary tendency from money supply is double that based on liquid liabilities. Policy implications and future research directions have been discussed.

Appendices

Appendix 1: Summary Statistics

		Variables	Mean	S.D	Min.	Max.	Obser.
	Financial Depth	Money Supply	0.397	0.246	0.001	1.141	267
		Liquid Liabilities	0.312	0.206	0.001	0.948	270
Financial Development	Financial Efficiency	Banking System Efficiency	0.638	0.349	0.070	2.103	296
		Financial System Efficiency	0.645	0.337	0.139	1.669	270
	Financial Activity	Banking System Activity	0.203	0.190	0.001	0.825	265
		Financial System Activity	0.214	0.200	0.001	0.796	270
	Fin. Size	Financial System Size	0.661	0.272	0.017	1.609	293
Dependent Variable		Consumer Price Index	20.524	32.416	-100.00	200.03	297

S.D: Standard Deviation. Min: Minimum. Max: Maximum. Obser : Observations. Fin : Financial.

Appendix 2: Variable Definitions

Variables	Sign	Variable Definitions	Sources
Inflation	Infl.	Consumer Prices (Annual %)	World Bank (WDI)
Economic financial depth (Money Supply)	M2	Monetary Base plus demand, saving and time deposits (% of GDP)	World Bank (FDSD)
Financial system depth (Liquid liabilities)	Fdgdp	Financial system deposits (% of GDP)	World Bank (FDSD)
Banking system allocation efficiency	BcBd	Bank credit on Bank deposits	World Bank (FDSD)
Financial system allocation efficiency	FcFd	Financial system credit on Financial system deposits	World Bank (FDSD)
Banking system activity	Pcrb	Private credit by deposit banks (% of GDP)	World Bank (FDSD)
Financial system activity	Pcrbof	Private credit by deposit banks and other financial institutions (% of GDP)	World Bank (FDSD)
Financial size	Dbacba	Deposit bank assets on Central banks assets plus deposit bank assets	World Bank (FDSD)

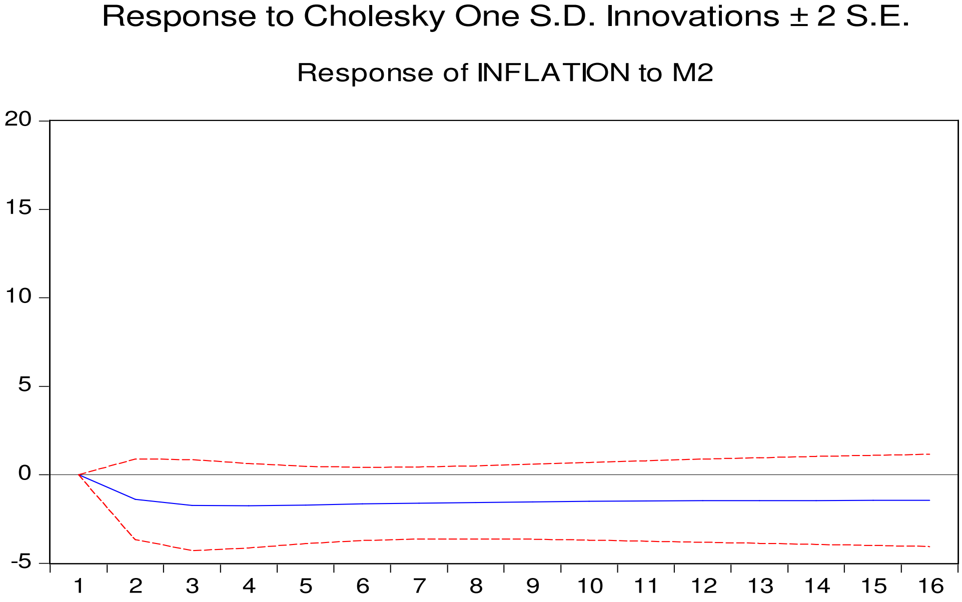
Infl: Inflation. M2: Money Supply. Fdgdp: Liquid liabilities. BcBd: Bank credit on Bank deposits. FcFd: Financial system credit on Financial system deposits. Pcrb: Private domestic credit by deposit banks. Pcrbof: Private domestic credit by deposit banks and other financial institutions. Dbacba: Deposit bank assets on Central bank assets plus deposit bank assets. WDI: World Development Indicators. FDSD: Financial Development and Structure Database.

Appendix 3: Correlation Analysis

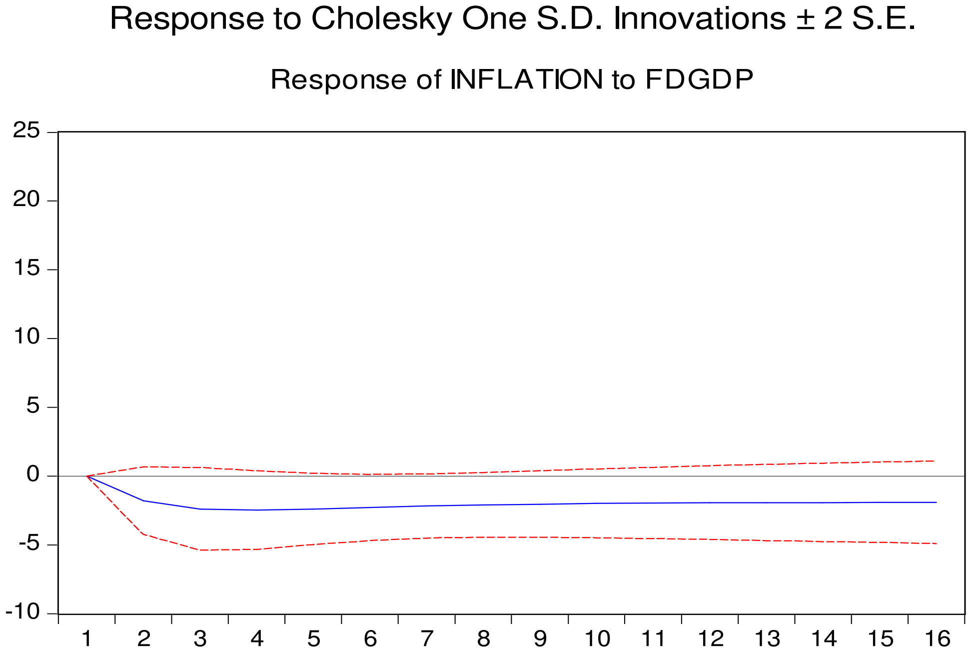
Financial Depth		Financial Efficiency		Financial Activity		Fin. Size	Inflation	
M2	Fdgdp	BcBd	FcFd	Pcrb	Pcrbof	Dbacba	Infl.	
1.000	0.987	0.172	0.199	0.776	0.758	0.503	-0.357	M2
	1.000	0.171	0.193	0.779	0.762	0.543	-0.380	Fdgdp
		1.00	0.955	0.674	0.684	0.408	-0.205	BcBd
			1.00	0.697	0.736	0.368	-0.211	FcFd
				1.00	0.985	0.541	-0.335	Pcrb
					1.000	0.552	-0.339	Pcrbof
						1.000	-0.566	Dbacba
							1.000	Inflation

M2: Money Supply. Fdgdp: Liquid liabilities. BcBd: Bank credit on Bank deposit (Banking Intermediary System Efficiency). FcFd: Financial credit on Financial deposits (Financial Intermediary System Efficiency). Pcrb: Private domestic credit (Banking Intermediary Activity). Pcrbof: Private credit from domestic banks and other financial institutions (Financial Intermediary Activity). Dbacba: Deposit bank assets on deposits banks plus central bank assets (Financial size). Infl: Inflation.

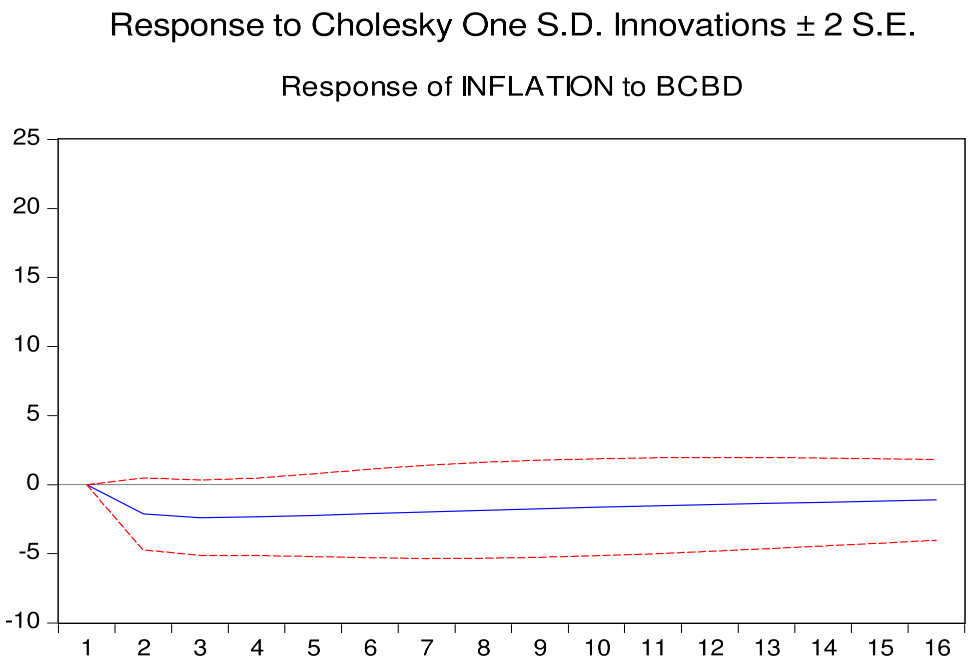
Appendix 4: Inflation and Money Supply (M2)



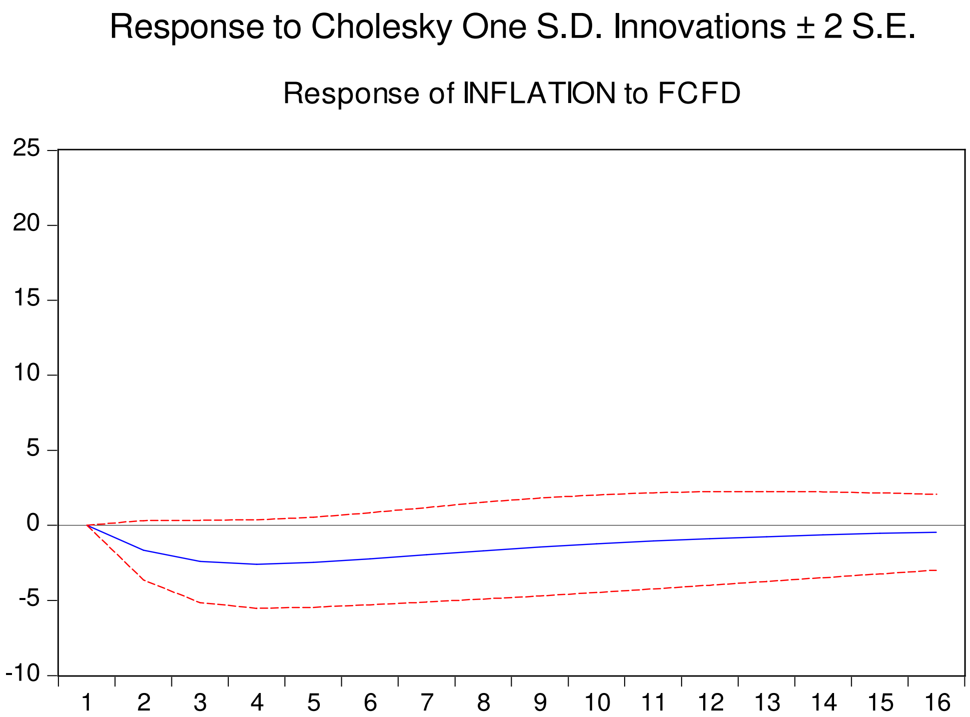
Appendix 5: Inflation and Liquid Liabilities (FDGDP)



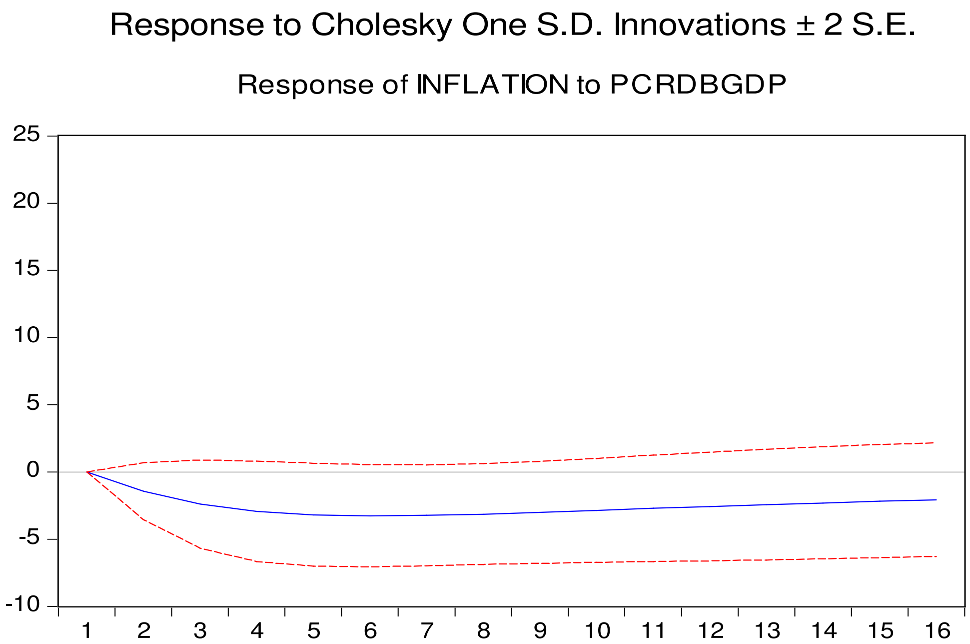
Appendix 6: Inflation and Banking System Efficiency (BCBD)



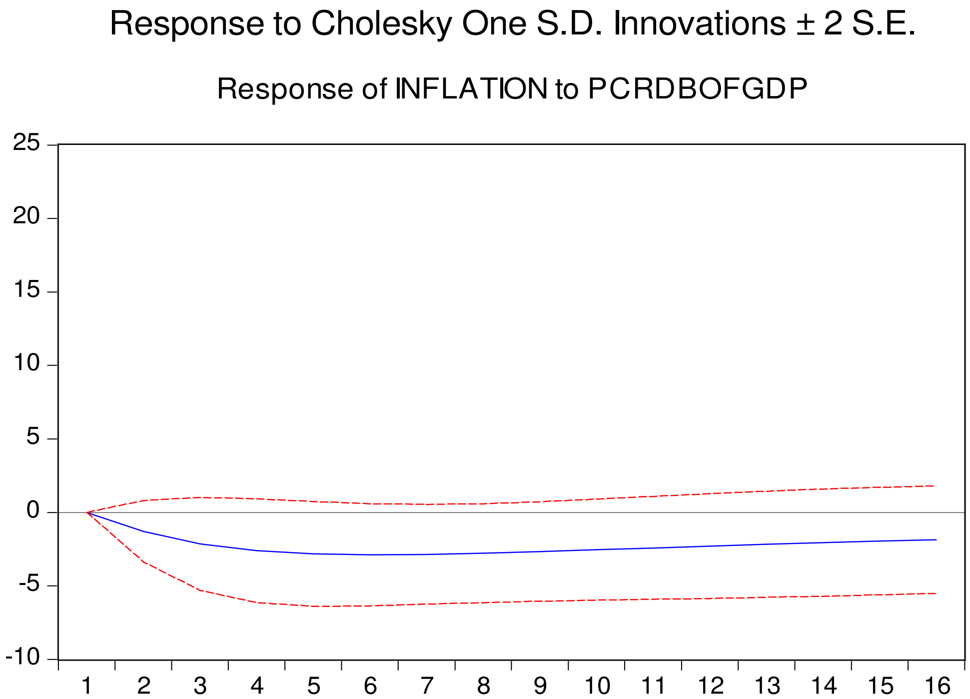
Appendix 7: Inflation and Financial System Efficiency (FCFD)



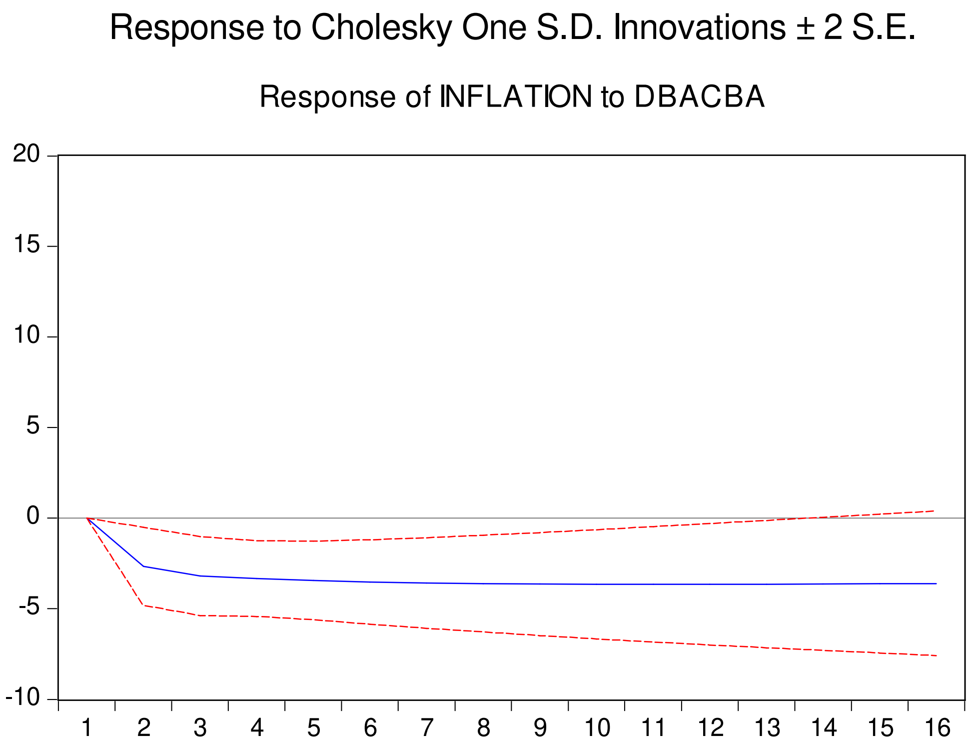
Appendix 8: Inflation and Banking System Activity (PCRDBGDP)



Appendix 9: Inflation and Financial System Activity (PCRDBOFGDP)



Appendix 10: Inflation and Financial Size (DBACBA)



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