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Financial sector development, economic volatility and shocks in sub-Saharan Africa

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HIGHLIGHTS

- Financial development affects business cycle volatility in a non-linear fashion.
- Well-developed financial sectors dampen volatility.
- Finance dampens (magnifies) the effect of real shocks (monetary shocks) on the components of volatility.

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ABSTRACT

The role of financial sector development in economic volatility has been extensively studied albeit without informative results largely on the failure of extant studies to decompose volatility into its various components. By disaggregating volatility using the spectral approach, this study examines the effect of financial development on volatility components as well as channels through which finance affects volatility in 23 sub-Saharan African countries over the period 1980–2014. Our findings based on the newly developed panel cointegration estimation strategy reveal that while financial development affects business cycle volatility in a non-linear fashion, its effect on long run fluctuation is imaginary. More specifically, well developed financial sectors dampen volatility. Further findings show that while monetary shocks have large magnifying effect on volatility, their effect in the short run is minuscule. The reverse, however, holds for real shocks. The channels of manifestation shows that financial development dampens (magnifies) the effect of real shocks (monetary shocks) on the components of volatility with the dampening effects consistently larger only in the short run. Strengthening financial sector supervision and cross-border oversight may be very crucial in examining the right levels of finance and price stability necessary to falter economic fluctuations.

1. Introduction

According to the IMF's [1] Regional Economic Outlook for sub-Saharan Africa (SSA), global growth stood at 3.1% in 2015 and is expected to marginally increase to 3.2% in 2016. While global growth largely remains unchanged, composition with SSA performance is bleak and less favourable. Economic activity in SSA has weakened markedly with large country-level variations. Growth for the region as a whole decreased to its all-time lowest in 15 years to 3.5% in 2015, and average growth

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for the region in 2016 is projected to further fall to 3%. The report highlights that, the most vulnerable SSA countries are the region's oil exporters. For them, the commodity terms of trade index dropped by 20% of GDP in a matter of a few years, after recording steady gains of about 45% during 2000–2014. Evidently, the macroeconomic effect is huge. IMF [1] found that a negative terms of trade shock of this size on average generates a slowdown in annual growth of 3–3.5 percentage points for several years after the shock.

With the exception of the region's middle-income countries (such as South Africa), both financial market depth and institutional development of the region remain lower compared to other developing regions. Given this understanding, there still remain substantial avenues for further financial development which could yield as much as 1.5 percentage points of additional economic growth on average for countries in SSA [1]. Evidence abounds of the positive relationship between financial development and economic growth [2–5]. While the empirical and theoretical literature has established a positive impact of financial sector development on economic growth [6–8], the potential links between financial development and volatility in developing countries and SSA in particular have been understudied despite the apparent rampant shocks. Specifically, the channels through which financial development potentially affects growth volatility remain unknown. More so, the extent of the volatility–financial development nexus is very mute in the literature. Meanwhile volatility, regardless of its source, is a natural source of worry in a world of market imperfections. This holds with particular force in developed economies where the financial sectors are relatively well developed. Some studies (see for instance [9]) have long revealed greater forms of volatilities in high income countries on account of greater economic concentration. Legitimate as it is, if volatility matters in developed economies, then it must pose an even greater source of concern for developing countries that are still struggling to meet basic needs.

Empirically, what we know so far on the financial development–volatility nexus is inconclusive. Denizer et al. [10] argues that countries with well-developed financial sectors experience lower fluctuations in output, consumption and investment growth suggesting the proportion of private credit best explains volatility. Similar findings are found by Easterly et al. [11] and Beck et al. [12]. These studies, however, assume a linear functional relationship between finance and volatility which may be untenable on account of recent evidence. The empirical analysis of Easterly et al. [13], Arcand et al. [14] and Dabla-Norris and Srivisal [15] suggest that the relationship between financial development and volatility is U-shaped suggesting that financial development acts as a shock absorber against volatility but only up to a point; beyond which further increases in financial systems exacerbate shocks thereby increasing volatility. Kunieda's [16] however, argues that such nexus is hump-shaped where effect of finance on growth depends on the stage of financial development. Specifically, during early stages of financial development, growth is less volatile and as the financial sector develops, the economy gets highly volatile but subsequently becomes less volatile once again as financial sector matures. On the time varying effect of financial development on volatility, Loayza and Ranciere [17] found a beneficial long run relationship between financial intermediation and output growth that co-exists with a mostly adverse short run relationship. Controlling for factors that may influence fluctuations in economic activity, Tiryaki [18] study reveals that although the long run volatility of the business cycle component of growth is dampened in countries with more developed financial system the short term response is mixed. While the above studies have documented some finance–volatility nexus, none of these studies have investigated the channels through which finance impacts on volatility. Studies on the transmission channels are scanty and those pertaining to SSA are almost non-existent.

Apart from the limited studies, the few existing works relied on standard deviation to measure volatility with no apparent distinction among the different volatility components. Our paper argues that the standard deviation approach is far from being informative as financial sector development and shocks impact on aggregate growth volatility through its business cycle and long run components. Volatility declines either as a consequence of a change in the nature of shocks or a change in how economies react to shocks. More importantly, the existing studies have failed to decompose volatility into its various components thereby obscuring how finance uniquely interacts with each component, and leaving out much of the richness of the volatility–finance–shocks relationships as most of the real world interactions can best be explained with disaggregated models of economic fluctuations hence our use of the spectral approach.[1]

This apparent and significant gap in the literature necessitates further research efforts in this direction as it presents a serious challenge to policy makers in the conduct of monetary and stabilization policies in the face of financial sector development. From academic and policy perspectives, there are two central questions this paper seeks to address. Do economies with higher levels of financial development experience more or less volatility? What are the channels through which financial development affects volatility components?

This paper can be thought of as a re-examination of the standard paradigm relating finance and macroeconomic stability. It makes two significant contributions to literature. First, this paper employs the spectral approach in extracting business cycle and long run components of growth volatility. Relative to previous studies,[2] this approach which provides instructive illustration on volatility, to the best of authors' knowledge has not been used in developing country context. The use of

[1] Our focus is not on the length of business cycles but rather on the cross-country volatility. It is imperative to note that financial sector development does not necessarily affect cycle length. In the face of higher uncertainty, investment irreversibility and indivisibility, economic recessions are expected to persist over a long time relative to boom and entrepreneurs will adamantly believe the economy is recovering and to begin to take positive investment decisions.

[2] Apart from standard deviations, band-pass filter and the generalized autoregressive conditional heteroskedasticity (GARCH) family have recently been used to estimate volatility (see [19–22]).

standard deviation as a measure of volatility cannot decompose volatility into its various components such as the long run and business cycle volatilities. As such, it is unable to show how financial development affects these types of volatilities let alone how it interacts with real and monetary shocks to influence volatility. Second, by decomposing volatility and in contrast to earlier studies (see for instance [20,23]), we further explore how financial development impacts on volatility component via effect on shocks.

Findings from the cross-country regressions show that while financial sector development affects business cycle volatility in a non-linear fashion, its effect on long run fluctuation is only imaginary. More specifically, well-developed financial sector dampens volatility at the business cycle. However, in the long run, unbridled financial development may magnify fluctuations. Further findings show that while monetary shocks have large magnifying effect on volatility at the long run business cycle, their effect in the short term is minuscule. The reverse however holds for real shocks. Our main conclusion is that irrespective of the component, volatility caused by monetary shocks is more important and persistent than those caused by real shocks and financial underdevelopment and factors driving fluctuations are largely internal. With regard to channels of manifestation, our evidence reveal that whether in the short or long term, financial development dampens (magnifies) the effect of real shocks (monetary shocks) on the components of volatility with the dampening effects consistently larger only in the short run.

The rest of the chapter is as follows: the next section contextualizes the study while Section 3 outlines the data and empirical strategy. Section 4 presents the findings with Section 5 highlighting the policy implications. Section 6 concludes the study.

2. Contextualizing financial development, shocks and volatility linkages

The high growth volatility that many developing countries experience has reignited the debate on whether and to what extent output variations relate to the development of the financial sector. Kiyotaki and Moore [24] note that credit market imperfections increase the effect of temporary shocks thus exacerbating their persistence. Theoretically, Bacchetta and Caminal [25] present a tractable dynamic general equilibrium model with asymmetric information in the credit markets. The idea is that information asymmetry is reflected in the evolution of agency costs. In their model, asymmetric information only matters whenever the level of internal funds and collateralizable assets is sufficiently low. In equilibrium lenders find it optimal to restrict the amount of credit only to those firms that can self-finance a low proportion of desired investment. They posit two co-existing firms: affluent firms with abundant cash flow and poor firms with little cash flow and the latter suffer from credit rationing. Thus, given decreasing returns to scale in production, credit-constrained firms exhibit higher diminishing marginal productivity. Their theoretical model finds that information asymmetry affects the relative output movements if it impacts on the allocation of funds between the credit-constrained and unconstrained firms culminating in a composition effect. This composition effect exacerbates the impact of a positive shock whenever the level of internal funds available to credit-constrained firms increases relative to the total amount of funds. Thus, whether asymmetric information amplifies or dampens output fluctuations depends on whether there is a redistribution of funds in favour or against credit-constrained firms.

Aghion et al. [26] develop a theoretical macroeconomic model on the basis of micro-foundations combining financial market imperfections with unequal access to investment opportunities. Their model shows that countries with underdeveloped financial systems tend to be more volatile and experience slower growth. They show that, low levels of financial development and the separation of savers from investors lead to vacillations in the macro-economy with the economy converging to a cycle around its steady-state growth trajectory. Conversely, under well-developed financial sector, economies converge to a stable growth path along which volatilities are only due to exogenous shocks. Aghion et al. [26] model suggests that supply and demand for credit tend to be cyclical when the financial sector is underdeveloped.

Beck et al. [27] build on Bacchetta and Caminal [25] model with an endogenous financial intermediation and two conditions for the existence of a bank-lending channel of monetary policy: (i) firms cannot substitute bank lending with alternative finance sources, and (ii) the monetary authority can affect the supply of credit. Beck et al. [27] consider only unanticipated productivity and monetary shocks and assume that agency costs do not influence output volatility hence providing no role for financial intermediaries influencing these shocks. The relative output effect of a shock that leads to a change in the relative wealth effect ratio of low and high entrepreneurs which is larger under asymmetric information than under perfect capital markets. The underlying intuition is that a well-developed financial sector alleviates the cash flow constraint for low entrepreneurs (or credit constrained firms) thus dampening the impact of shocks on the production function while magnifying the effect on monetary shock. On the impact shock on volatility, their model show that the effect of real (monetary) volatility on output and growth volatility is larger (smaller) under asymmetric information than under well-developed financial system and increases (decreases) in agency costs.

The theoretical underpinnings above mimic the proposition that if two economies vary in terms of volatility, the spectrum of the country experiencing low fluctuations will disproportionally lie underneath at the business cycle. This is particularly evident if the lower fluctuation largely emanates from a positive spill-over from improved business practices that falters output overtime. And if financial sector development mitigates business cycle volatility, then economies with well-developed financial systems will have their spectrum disproportionally lower at the business cycle component relative to those with underdeveloped financial sector. According to Gertler [28] and Levine [29], financial intermediaries decrease the costs of acquiring information and aid in reducing transaction costs. In doing so, the financial sector help to ameliorate

Table 1
Summary statistics.
Source: Authors' estimations using data from WDI.

Variables	Mean	Std. dev.	Coefficient of variation	25th PCT	50th PCT	75th PCT	Skewness	Kurtosis
Real GDP per capita	1405.88	1964.41	1.40	377.72	546.91	1061.84	2.07	6.11
GDP growth rate	3.65	5.58	1.53	1.45	3.98	6.05	−1.13	20.10
Government expenditure	15.44	6.60	0.43	11.24	14.17	18.13	1.55	6.76
Inflation	55.60	36.13	0.65	27.80	51.01	83.36	0.37	2.74
Inflation volatility	1.97	0.73	0.37	0.41	0.72	1.33	−1.91	6.97
Trade openness	71.91	35.34	0.49	45.81	63.63	92.26	0.94	3.54
Foreign aid	53.25	5.02	0.09	50.80	52.42	54.32	−1.46	28.91
Terms of trade volatility	1.15	0.17	0.15	0.68	1.21	1.98	0.07	3.37
Domestic credit	21.64	23.63	1.09	9.77	15.34	24.88	3.45	16.40
Private credit	18.91	15.53	0.82	9.23	15.03	23.81	2.28	9.52

information asymmetries, improves corporate governance and efficiently allocates resource. However, its long run effect is still unclear. In fact Aghion Banerjee's [30] model is capable of spawning endogenous fluctuations under credit constraint economy where long run fluctuation is only a possibility for countries with underdeveloped financial systems and low level of financial intermediation. In their model, financial underdevelopment interacts with interest rate (or real exchange rate in open economy) resulting in volatility which can be persistent. Borrowing and investments are higher during boom period increasing the debt burden of firms resulting from higher interest rate thereby thwarting firm's wealth and investment capacity which may well fall below the economy's total savings. The economy eventually goes into recession driving down interest rates. In financially developed economies, firms invest up to the expected capacity of their projects because they face no credit constraints. However, in less developed financial economies, firms entirely depend on retained earnings for investments and do not experience long run fluctuations expected for those economies with intermediate financial systems.

Leveraging from the foregoing, we hypothesize that financial sector development only affects volatility at the business cycles while shocks impact on both long run and business cycle volatility components and are dampened or magnified depending on their nature. More specifically, because financial deepening makes available credit for investment and consumption, shocks that only affect the real sector via terms of trade are dampened whereas shocks that directly affect the monetary and financial sector via inflation are magnified.

3. Data and methodology

3.1. Data

We test our hypothesis by constructing a panel dataset of 23 SSA countries for the period 1980–2014.[3] The choice of these countries is based entirely on data availability for a sufficiently longer time period. Annual data for the variables were gleaned from the World Development Indicators (WDI) of the World Bank and Analyse Africa. We used credit to the private sector as percentage of GDP to proxy the quality of financial development since it is the widely used measure finance development (see for instance [14,3,2]) and accounts for credit advanced to the private sector that propelling the utilization and allocation of funds to more efficient and productive activities. Arguably, monetary aggregates are not good proxies since they only resonates the extent of transaction services offered by the financial sector relative to its ability to relocate funds from depositors to investors [31]. The inflation variable is the annual percentage change in the consumer price index while terms of trade is the net barter terms of trade computed as the ratio of export to import price. With regard to the shock variables, monetary and real shocks are respectively proxied by inflation and terms of trade volatilities estimated by means of generalized autoregressive conditional heteroskedasticity (GARCH, 1, 1) developed by Bollerslev [32]. Relative to the traditional approaches, our choice of this approach rests on its ability to harvest past values and behaviour of the series. See Fig. 1 in the Appendix for the shocks plot. We also include government expenditure and trade openness to assess their contribution to economic fluctuations. Government expenditure expressed as a percentage of GDP measures final government consumption expenditure and used to measure government size. Table 1 presents the summary statistics of the variables.

All variables are averaged over the sample period and suggest that real GDP per capita $1405.88 reaffirming the rather low income levels of the sample countries. A scatter plot of financial development and economic growth is presented in Fig. 2 in the Appendix. Average real GDP growth rate is estimated at 3.65% with a standard deviation of 5.58. Private credit to GDP ratio is averaged 18.91% relative to domestic credit of 21.64%. The mean government size as a percentage of GDP is also averaged 15.44%, fairly higher than the median (14.17%). To allow for relative comparison of the variables in terms of fluctuations, we estimate the coefficient of variation (CV) as the ratio of standard deviation to mean. GDP growth rate and per capita income are the most volatile variables given their rather high CV although the former is exceedingly higher.

[3] The countries are Benin, Botswana, Burkina Faso, Cameroon, Central African Republic, Chad, Congo, Rep., Cote d'Ivoire, Ethiopia, Gabon, Gambia, Ghana, Kenya, Lesotho, Madagascar, Malawi, Mauritania, Mauritius, Nigeria, Rwanda, Senegal, South Africa and Togo.

Foreign aid is the least volatile with an average of 53.25%. All the variables are skewed to the right except the GDP growth rate, inflation and development assistance. Financial development proxies are also positively skewed and so is real GDP per capita. The next section discusses the empirical strategy employed to examine the finance–shocks–volatility nexus.

3.2. Empirical strategy

3.2.1. Decomposing growth volatility

As discussed earlier, extant studies have used standard deviation of GDP per capita to proxy volatility. However, the use of standard deviation does not distinguish among the different components of volatility. Following Mallick [33], we decompose growth volatility into different components using the frequency domain approach by first calculating variance and its components relying on spectral method and by taking the square root to estimate volatility. By assuming a covariance stationary growth series, its variance is expressed as the integral of the spectrum of the series, $g(\omega)$, across all frequencies $-\pi \leq \omega \leq \pi$. The implication is that a country with relatively lower growth variance would have a spectrum lying proportionally below the one for the country with relatively higher growth variance. We leverage on the Wold's theorem which indicates that the covariance-stationary output growth has an infinite Moving Average process MA(∞). Given that the spectrum of any MA process is proportional to its corresponding innovation variance, the country with a higher volatility of shocks will experience a relatively higher innovation variance than the other although coefficients of the MA stay the same. We decompose volatility into different components given that a particular component of the variance is the integral of the spectrum over the respective frequency ranges. For instance, our long run volatility is estimated as the integral of the spectrum over the long run frequency range. The business cycle component of the variance is also estimated in the same fashion. Our spectrum is symmetric around zero such that only frequency range $0 \leq \omega \leq \pi$ is crucial. Given a covariance-stationary, y_t, the periodogram, a sample analog of the spectrum is given as:

$$\hat{g}(\omega) = \frac{1}{2\pi} \sum_{j=-N+1}^{N-1} \hat{\gamma}^j e^{-i\omega j} = \frac{1}{2\pi} \left[\hat{\gamma}^0 + 2 \sum_{j=1}^{N-1} \hat{\gamma}^j \cos(\omega j) \right] \tag{1}$$

where $\hat{\gamma}^j$ is the jth order sample autocovariance given by:

$$\hat{\gamma}^j = \frac{1}{N} \sum_{t=j+1}^{N} (y_t - \bar{y}) \left(y_{t-j} - \bar{y} \right) \tag{2}$$

for $j = 0, 1, 2, \ldots, (N-1)$ where $\bar{y}$ is the sample mean given as $\frac{1}{N} \sum_{t=1}^{N} y_t$. Since our spectrum is symmetric around zero, $\hat{\gamma}^j = \hat{\gamma}^{-j}$ and the integrated periodogram for the frequency range (ω_1, ω_2) is therefore given as:

$$\hat{G}(\omega_1, \omega_2) = 2 \int_{\omega_1}^{\omega_2} \hat{g}(\omega)\, d\omega = \frac{\omega_2 - \omega_1}{\pi} \hat{\gamma}^0 + \frac{2}{\pi} \sum_{j=1}^{N-1} \hat{\gamma}^j \frac{\sin(\omega_2 j) - \sin(\omega_1 j)}{j}. \tag{3}$$

It is imperative to note that Eq. (3) denotes the variance of the series y_t, attributed to the frequency range $\omega_1 \leq \omega \leq \omega_2$ where the frequency ω is inversely related to periodicity according to $p = \frac{1}{\omega} 2\pi$. Since our interest is on decomposing the volatility components, the frequency ranges of the business cycle and long run are respectively given as $\omega_1 \leq \omega \leq \omega_2$ and $0 \leq \omega \leq \omega_1$. Given the annual series of our variables, we follow Mallick [33] in choosing the values of ω_1 and ω_2 to respectively represent 0.79 and 2.09. Indeed, these threshold frequencies are chosen consistent with extant literature on business cycle (see for instance [34,33]) with the axiom that the long run comprise of cycles of at least 8 years while business cycle correspond to 3–8 years [34]. Instructively, since our dependent variable – volatility components – are "generated", measurement error can potentially influence our estimates as it corrupts estimates at high frequency range. We avoid this by exclusively focusing on business cycle and long run components of the volatility on account of its exclusion of high frequency ranges. We first calculate variance (and its components) using spectral method, and then take the square root to calculate volatility.

3.2.2. Dynamic panel estimations

The primary aim of this study is to examine the effect of financial development and shocks on growth volatility components and how financial development play out in mitigating or otherwise propagating monetary and real shocks in the growth volatility process using a balanced panel sample of 23 countries ($N = 23$) over a 34-year period ($T = 34$). Pesaran et al. [35] propose estimating a dynamic model by either averaging the individual country estimates—Mean Group (MG) – or by pooling the long run parameters – Pooled Mean Group (PMG). We adopt the PMG approach as it combines the efficiency of pooled estimation and at the same time avoids the inconsistency problem stemming from pooling heterogeneous dynamic

relationships.[4] This procedure fits an error correction model in an autoregressive distributed lag ARDL (p, q) technique of which we specify as:

$$\Delta(Vy_i)_t = \delta_i\left[(Vy_i)_{t-1} - \left\{\theta_{0,i} + \theta_{1,i}(Z_i)_{t-1}\right\}\right] + \sum_{j=1}^{p-1}\alpha_{i,j}\Delta(Vy_i)_{t-j} + \sum_{j=0}^{q-1}\gamma_{i,j}\Delta(Z_i)_{t-j} + \varepsilon_{i,t}$$
$$i = 1, 2, \ldots, 23;\ t = 1, 2, \ldots, 34 \tag{4}$$

where Vy is a vector of growth volatility components; Z is a vector of regressors including financial development, shocks and other controls; α and γ are the short run coefficients related to growth volatility and its drivers; θ are long run coefficients; δ is the speed of adjustment to long run equilibrium while ε represents the time-varying disturbance with i and t denoting country and time indices respectively.

4. Empirical results

This section discusses the empirical findings of the study. The first part presents results on the relationships using our standard measure of financial development – private credit – and dynamic panel approach. In Section 2, we report the sensitivity analysis employing both a different financial development proxy and estimation approach.

4.1. Estimation and interpretation of the short and long run relationships

We estimate the short and long run relationships between the volatility components and the regressors having established cointegration among the series considered.[5] This is done relying on the PMG and MG with the latter being an alternative. While the PMG estimator relies on the panel extension of the single equation in ARDL framework, the MG allows heterogeneity among the long run parameters. As an advantage, the ARDL highlights information about the contemporaneous effects and the speed of adjustment towards long run equilibrium following a shock. With regard to endogeneity, Pesaran and Shin [35] argue that, under the ARDL framework, endogenous regressors can be addressed by the PMG where the regressors are $I(1)$, subject to some restrictions including existence of a unique cointegrating relationship among the variables. Specifically, "Appropriate modification of the orders of the ARDL model is sufficient to simultaneously correct for the residual serial correlation and the problem of endogenous regressors" [35, 386]. To explore these endogeneity issues we first checked whether our variables are $I(0)$ or $I(1)$ and whether they are cointegrated. In our current paper, we mitigate potential endogeneity by appropriately augmenting the lag structure to ARDL (1, 1, 1, 1, 1, 1).[6] While the short run coefficients are assumed to be heterogeneous and country-specific, the long run parameters are taken as homogeneous and identical across the panel. Table 2 presents results on the estimations of the PMG and MG.

We interpret the coefficients as elasticities since all the variables are in their natural logarithms. Starting with the long run effects of the regressors, results from Table 2 show that both the PMG and MG have robustly positive impact of trade openness on all the volatility components. Specifically, an increase in trade openness heightens volatility around its business cycle and so is the long run volatility although coefficients produced by MG are consistently higher. For instance, in the long run, findings from the PMG reveal that a unit-percentage increase in trade openness significantly propagates business cycle volatility by 0.178% compared to 0.194% from the MG. Long run volatilities are also consistent and generally reveal that, in SSA further increases in trade openness increases volatility. The implication is that reduction in barriers to trade perhaps increases countries' susceptibility to external shocks thus exacerbating growth vagaries. Theory suggests that greater openness to trade might in principle provide a mechanism for smoothing consumption and production in the face of shocks, but at the same time could expose a country to greater volatility as exogenous shifts in trade disrupt economic activity. What is noted from our finding is that greater openness exposes economies to sever volatilities at all levels. To the

[4] Our approach can also be applied whether the series are $I(0)$ or $I(1)$ downplaying the need for unit root testing We nonetheless examine the stationarity properties of the series based on five different panel unit root tests: Levin–Lin–Chu's [36] t^*, Breitung's [37] t, Hadri's [38] Z, Im–Pesaran–Shin's [39] W-t-bar, and Maddala and Wu's [40] χ^2 statistics. The findings show evidence of $I(0)$ and $I(1)$ series and are available upon request.

[5] We used three distinct panel cointegration tests: the Pedroni, Kao and Westerlund. Our spectral estimations are conducted relying on the Bartlett kernel where the bandwidth is selected by Newey–West algorithm. All tests are conducted under the null hypothesis of no cointegration. We also included deterministic time trends in all the specifications. Results from Pedroni tests do not show any sign of cointegration between business cycle volatility and the regressors when we assume common autoregressive coefficients. However, the Panel-v test shows some level of cointegration among the variables and long run volatility. When individual autoregressive coefficients are assumed, only the Group-ADF test shows evidence of cointegration among volatility components and the variables. The Kao test on the other hand does not reveal any long run relationships given the high p-values. With regard to the Westerlund tests and with business cycle volatility as the dependent variable, while the G_T statistic show no evidence of cointegration between the dependent variable and its covariates, the G_α rejects the null hypothesis of no cointegration at 10% significance level. Turning to long run volatility as distinct dependent variable, while G_α statistic do not show evidence of cointegration, G_T statistic strongly suggests that, long run volatility share common stochastic trend among the associated covariates as null hypotheses of no cointegration are both rejected. Thus, our results generally show evidence of cointegration among each volatility component and its associated covariates. For brevity, we do not include the cointegration results but are available upon request from the authors.

[6] We thank the anonymous reviewers for raising this point.

Table 2
Financial development, shocks and volatility.
Source: Authors' estimations.

Variables	Dependent variables			
	Business cycle volatility		Long run volatility	
	PMG	MG	PMG	MG
Long run coefficients:				
Trade openness	0.178*	0.194*	0.163*	0.219*
	(2.910)	(2.611)	(3.171)	(3.541)
Government expenditure	0.114	0.215	0.098***	0.137
	(1.310)	(1.516)	(1.993)	(1.621)
Foreign aid	0.811	0.733	−0.219	0.315
	(1.412)	(1.555)	(−1.496)	(1.501)
Financial development	−0.217*	−0.138*	−0.331	−0.271
	(−5.374)	(−7.013)	(−1.401)	(−1.501)
Financial development_Sq	0.443**	0.392**	0.213	0.246
	(2.202)	(2.381)	(1.474)	(1.011)
Shocks:				
Monetary shock	0.721**	0.815*	0.610*	0.774*
	(2.531)	(4.341)	(4.521)	(3.912)
Real shock	0.221**	0.278**	0.437**	0.491*
	(2.170)	(3.013)	(2.884)	(3.714)
Error correction term	−0.745*	−0.621*	−0.687*	−0.572*
	(−4.118)	(−3.914)	(−3.701)	(−3.821)
Short run coefficients:				
Δ Trade openness	0.221***	0.277**	0.307	0.301
	(1.987)	(2.310)	(1.501)	(1.614)
Δ Government expenditure	0.247	0.312	0.418	0.501
	(1.441)	(1.517)	(1.681)	(1.433)
Δ Foreign aid	0.723	0.644	0.864	0.701
	(1.019)	(1.152)	(1.277)	(1.318)
Δ Financial development	−0.112	−0.107	−0.212	−0.197
	(−1.371)	(−1.533)	(−1.349)	(−1.276)
Δ Financial development_Sq	0.981	0.997	0.662	0.721
	(1.171)	(1.038)	(1.559)	(1.619)
Shocks:				
Δ Monetary shock	0.317**	0.384***	0.412	0.474
	(2.151)	(1.981)	(1.531)	(1.607)
Δ Real shock	0.313***	0.372**	0.218**	0.287**
	(1.991)	(2.011)	(2.717)	(2.510)
Intercept	−1.233	−1.772	−1.547	−1.827
	(−3.781)	(−3.922)	(−3.792)	(−4.018)
Hausman test [χ^2]		2.113[0.945]		0.974[0.982]
Number of countries	23	23	23	23
Number of observations	806	806	806	806

Notes: Values in ( ) are the test statistic. All variables are in logs and all the regressions include the full set of controls including country and time effects. Estimations are done using stata command xtpmg. The threshold value is the value after which financial development exacerbates volatility. The lag structure is ARDL (1, 1, 1, 1, 1, 1).
* Denote significance at 1%.
** Denote significance at 5%.
*** Denote significance at 10%.

extent that SSA countries have imperfect financial markets it also exposes the economies to external shocks and greater output volatility.

Turning to the effect of shocks on volatility components, our results suggest that both monetary and real shocks are important sources of volatility both at the business cycle and long run component of macroeconomic volatility. These findings are robust to estimation approach although the MG provides higher estimates. Specifically and following from the PMG, our findings reveal that a unit-percentage rise in inflation fluctuations heightens business cycle and long run volatilities by 0.72% and 0.61% respectively. While monetary shock magnifies growth vagaries, its effect on business cycle volatility component is consistently higher than the long run component. Our finding is in synch with the monetarist view of destabilizing intervention: volatile monetary shock is associated with more pronounced business cycle. Theory

postulates that whether output fluctuation is enhanced or dampened by inflation volatility depends on the source of shock to the economy: inflation volatility is expected to stem the tide of macroeconomic volatility when shock emanates from wage-setting but not when originating in aggregate demand (see [41,42]). To the extent that monetary shock proxied by inflation variability destabilizes volatility components highlights aggregate demand as an important source of volatility in SSA. Indeed, rising aggregate demand can be associated with higher inflation especially when demand is not proportionally accompanied by higher output and productivity.

The effect of real shocks is not different from the monetary shocks in terms of direction. Its coefficients are robustly positive suggesting that increases in real shocks magnify volatilities. Indeed, variations in commodity prices are an important source of external shocks. As far as the PMG estimator is concerned, at the business cycle, a unit-percentage increase in real shock significantly increases fluctuation by 0.221% compared to 0.278% of the MG estimates although monetary shocks appear to be an important source of growth fluctuations than external shocks given their relative elasticities. This notwithstanding, the contribution to real shocks to both business cycle and long run volatilities cannot be taken for granted. Changes in the terms of trade affect the economy via relative price movements of imported input and exported output. As such, shocks to terms of trade should directly affect the tradable sector of an economy and indirectly impacts on the non-tradable sector.

IMF [1] reports that, most episodes of terms of trade declines in SSA occurred in the 1980s and 1990s, and on average lasted five years, had deleterious growth effects in a number of commodity exporting countries such as Cote d'Ivoire, Guinea, Nigeria, and Zambia. Indeed, economies with large non-tradable sector will be relatively less pruned to fluctuations in the terms of trade. What is perceptible from our finding is a significant effect of external shock on volatility with much higher impact on persistence.

Government expenditure does not significantly affect business cycle volatility although its coefficient is positive. Our finding is inconsistent the notion that government plays as stabilizing role in the macroeconomy with its spending as espoused by Keynesian economics. While output volatility may decrease with government size in developed economies (see for instance Karras and Song, [43]), what is apparent from our results is that, in the case of SSA, government spending does not have any significant impact on business cycle volatility and even if government expenditure matter in volatility, its role is rather a destabilizing one particularly at the long run growth volatility component. This is noticeable given the positive and significant coefficient when estimated with the PMG. This evidence reveals that in the long run, effect of government's fiscal policy is benign at the business cycle but not the long run component as pro-cyclical fiscal policies and unbridled spending tend to magnify volatility persistence. The differences in direction of effect may largely emanate from the quality of spending rather than size.[7] More importantly, discretionary fiscal policy when subject to long time lags may well end up magnifying fluctuations.

The coefficients of foreign aid are positive except the PMG estimator in the long run volatility component. However, none of these effects are significant suggesting that Foreign aid does not explain any component of growth volatility whether we assume homogeneous coefficients or we allow them to vary. Consistent with our hypothesis, while the coefficients of financial development are negative in all the estimations, only its impact on business cycle volatility is significant. The implication is that higher financial development is only associated with lower volatility at the business cycle component. Well-functioning financial markets should facilitate a closer match between savers and investors and help absorb exogenous shocks in the real sector, promote diversification and potentially reduce risks and cyclical fluctuations. Given that volatility changes respond to the propagation mechanism via financial development, economies with relatively higher levels of financial sector development will have disproportionately lower volatility around their business cycle component relative to those with underdeveloped financial markets. Thus, volatility at only the business cycle component will by far be dampened by financial development. In financially underdeveloped economies like those in SSA, firms may rely entirely on retained earnings for investment due to credit constraints exacerbating volatility. As private credit increases in response to growth in the financial sector, funds available to entrepreneurs increase thus dampening business cycle volatility. More specifically, firms with higher liquidity needs experience higher volatility at the business cycle. Our finding therefore opines that the development of financial system reduces volatility as it provides distress firms with cash flow for increase investment.

Does financial development always mitigate volatility? We include a quadratic term of financial development to capture threshold effects and our evidence reveals that while deeper financial system is significantly associated with less volatility at the business cycle, such relationship appears to be intrinsically nonlinear. The squared term of financial development is positive and statistically significant. This finding implies that, while developed financial systems provide opportunities for stabilizing business cycle volatility, they may also entail higher leverage of firms hence more risk and less stability. As the financial system continues to grow relative to GDP, the increase in risk becomes more crucial and acts to reduce stability. The coefficient estimates indicate that this threshold is 24.49% of GDP for PMG. Countries where financial development exceeded these thresholds included Mauritius, Mauritania, Senegal and South Africa. Above these levels, business cycle volatility increases with the level of financial development. This is perhaps evident when economies like those in SSA experience rapid credit growth relative to real sector needs. In fact, Ibrahim and Alagidede [44] present evidence that unbalanced growth in finance and real sector destroys investment rates potentially magnifying macroeconomic volatility.

With regard to short run dynamics, all the coefficients maintain their signs except the level of significance. Our findings show that only international trade openness and shocks are significant. And even so, trade openness is significant at only the

[7] See [44].

business cycle component of growth volatility. Consistent with the long run finding, deregulating trade restrictions magnify business cycle fluctuation. What is clear from the results is the higher short run elasticities relative to long run. For instance, estimations from the PMG reveal that in the short term, a unit-percentage increase in trade openness significantly increases business cycle volatility by 0.221% compared to the long run coefficient of 0.178%. Indeed, economies' vulnerability is largely driven by either their structure or their level of economic development. Developing countries like those in SSA by their nature are more exposed to shocks and they do not always have the necessary and sufficient mechanisms and/or internal conditions to enable them to absorb shocks. This perhaps explains why the impact of trade openness at the business cycle component is more pronounced in the short run as its long run effect appears to fade perhaps as economies begin to adjust and develop some mitigating force.

Government expenditure and foreign aid do not influence short term fluctuations in growth components although their coefficients are positive and consistent with long run finding. While the coefficient of financial development is negative at all components, none of the effects is significant suggesting that, in the short run development of financial sector does not dampen macroeconomic volatility.

In the long run, while monetary shock aggravates business cycle and long run volatilities, in the short run, its effect on long run volatility is only imaginary given the insignificant coefficients. Importantly, the magnitudes of effect suggest that short run monetary shock has a less magnifying impact on economic volatility compared to its long term effect. More specifically, variations in business cycle volatility increases between 0.317% and 0.384% for every 1% rise in monetary shock. Further results reveal that while monetary shock only affects business cycle, in the short run real shock affects both business cycle and volatility persistence. Specifically, the coefficients of monetary shock are robustly positive and significant consistent with the long run finding: increases in terms of trade shock magnify macroeconomic volatility. However, the elasticity of business cycle volatility to short run fluctuations in external shock is greater than its long run effects reflecting the importance of terms of trade shock in fuelling short term fluctuations at the business cycle. The reverse is true for the long run volatility. The error correction term which measures the speed of adjustment to long run equilibrium is correctly signed and robustly significant at 1% under the two estimators. The significance of the error correction terms indicate that the models instantaneously return to their equilibrium levels following a shock to the system resulting from deviation of the long run path from its steady state.

So far our evidence presented above suggests that well developed financial sector significantly dampens macroeconomic volatility via various components but silent on the transmission channels. In this next section, we empirically examine the channels through which financial development mitigates the effects of volatility. We hypothesize that the development of efficient financial system impacts on volatility through its effect on shocks. We examine this by including interaction terms of private credit, monetary and real shocks in the volatility equation while controlling for covariates and findings are shown in Table 3.

As regards to the controls, in the long run the effect of trade openness in exacerbating both business cycle and long run volatilities is robust confirming earlier finding that de-restriction of trade barriers can be associated with severe volatility albeit varying magnitude owing to the estimation technique. While this holds, the long run impact of increase in trade openness on volatility persistence is enormous in both estimations with effect on long run volatility measuring three times higher than that of business cycle volatility.

Fiscal policy measured by government expenditure is positive in all the models suggesting some magnifying effect in the long term. However, none of the coefficients is significant at conventional levels consistent with majority of the baseline findings that government's use of fiscal policy as a tool to tame long run economic fluctuations may not be effective based on our sample evidence.

Both real and monetary shocks amplify fluctuations given their positive coefficients with estimates under the MG for the business cycle being slightly significant. While the effect of monetary shock appears critical, these findings confirm that terms of trade shock and persistent inflation fluctuation are both unhealthy for internal stability. As regards to relative strength in the propagating effect, our findings reveal that the long run effect of inflation shock on business cycle volatility is at least twice as the real shock and the relative effect produced by the MG is exceedingly higher.

Consistent with our earlier finding, the coefficient of financial development is negative and only significant at the business cycle volatility indicating that even when channels of manifestation are controlled for, well developed financial system is associated with reduced volatility. The coefficient of the square term is however negative and significant. The difference in signs reveals the existence of long run U-shaped nexus in finance–volatility affirming the need to include quadratic term of private credit to reflect the threshold effect that too much finance has painful consequence for internal stability. In terms of manifestation, our evidence reveal that financial development magnify the effect of monetary shock on both business cycle and long run volatilities. However, its magnifying effect on the latter is higher. More specifically, an increase in private credit from its 25th percentile (9.23%) to the median (15.03%) exacerbates business cycle and long run volatilities by 0.21 and 0.16 percentage-points respectively.[8] By investigating whether financial system dampens or exacerbates monetary shocks to the economy relying on cross-sectional data on 88 countries, Lensink and Scholtens [45] find that financial development smoothes the negative impact of inflation uncertainty on macroeconomic volatility thus contrasting our findings. Perhaps

[8] This is estimated first by calculating the percentage increase from the 25th percentile to the median value and multiplying the result by the coefficient of the interaction term at the respective volatility component.

Table 3
Transmission channels, shocks and growth volatility.
Source: Authors' estimations.

Variables	Dependent variables			
	Business cycle volatility		Long run volatility	
	PMG	MG	PMG	MG
Long run coefficients:				
Trade openness	0.112**	0.142***	0.329**	0.391**
	(2.018)	(1.998)	(2.318)	(2.720)
Government expenditure	0.210	0.414	0.253	0.119
	(1.009)	(1.256)	(1.811)	(1.721)
Foreign aid	0.552	0.420	0.192	0.217
	(1.669)	(1.821)	(1.591)	(1.681)
Financial development	−0.196**	−0.119**	−0.215	−0.171
	(−2.036)	(−2.112)	(−1.700)	(−1.605)
Financial development _Sq	0.312*	0.163*	0.271	0.222
	(3.502)	(3.409)	(1.515)	(1.049)
Shocks:				
Monetary shock	0.551**	0.793***	0.561**	0.772**
	(2.190)	(1.985)	(2.810)	(2.601)
Real shock	0.208**	0.211**	0.314**	0.403*
	(2.099)	(2.633)	(2.191)	(3.182)
Transmission channels:				
FD × Monetary shock	0.191**	0.214**	0.256**	0.428**
	(2.823)	(2.511)	(2.501)	(2.577)
FD × Real shock	−0.199**	−0.201**	−0.291***	−0.312**
	(−2.513)	(−2.790)	(−1.968)	(−2.701)
Error correction term	−0.612**	−0.559**	−0.591**	−0.495*
	(−2.914)	(−2.700)	(−2.930)	(−3.161)
Short run coefficients:				
Δ Trade openness	0.201***	0.213**	0.371***	0.309
	(1.974)	(2.001)	(1.981)	(1.801)
Δ Gov't expenditure	0.523	0.412	−0.701	0.611
	(1.023)	(1.554)	(1.765)	(1.621)
Δ Foreign aid	0.332	0.341	0.500	0.552
	(1.221)	(1.033)	(1.473)	(1.691)
Δ Financial development	−0.852***	−0.741	−0.633	−0.602
	(−1.981)	(−1.715)	(−1.577)	(−1.617)
Δ Financial development_Sq	0.331	0.282	0.292	0.310
	(1.503)	(1.299)	(1.777)	(1.672)
Shocks:				
Δ Monetary shock	0.299**	0.332**	0.360	0.299
	(2.033)	(2.501)	(1.771)	(1.632)
Δ Real shock	0.341*	0.339**	0.312**	0.290***
	(3.910)	(2.881)	(2.766)	(1.920)
Transmission channels:				
FD × Monetary shock	0.319*	0.401*	0.399**	0.290**
	(4.011)	(3.061)	(2.810)	(2.511)
FD × Real shock	−0.381**	−0.396**	−0.419**	−0.398***
	(−2.610)	(−2.901)	(−2.111)	(−1.998)
Intercept	−1.251**	−1.411**	−1.802***	−1.771**
	(−2.803)	(−2.912)	(−1.970)	(−2.004)
Hausman test [χ^2]		1.952[0.791]		1.821[0.822]
Number of countries	23	23	23	23
Number of observations	806	806	806	806

Notes: Values in ( ) are the test statistic. All variables are in logs and all the regressions include the full set of controls including country and time effects. Estimations are done using stata command xtpmg. The threshold value is the value after which financial development exacerbates volatility. The lag structure is ARDL (1, 1, 1, 1, 1, 1).
* Denote significance at 1%.
** Denote significance at 5%.
*** Denote significance at 10%.

the relationship between inflation shock and volatility as highlighted in their study is largely driven by the low (high) inflation (financial development) experienced by the developed countries contained in their sample.

Consistent with our hypothesis, the coefficient of the interaction term of private credit and terms of trade shock enters with a negative sign suggesting a dampening effect on macroeconomic volatility. Specifically, we find that in the long term while trade openness increases macroeconomic fluctuations, developed financial sector reduces the impact of terms of trade shocks on both business cycle and volatility persistence in more open economies. Given the coefficient of the interaction terms and relying on the PMG estimates, increase in financial development from its 25th percentile (9.23%) to the median (15.03%) dampens business cycle and long run volatilities by 0.125 and 0.183 percentage-points respectively. All these results taken together imply that financial development helps mitigate macroeconomic volatility even after controlling for monetary and real shocks, thus providing support for the role of financial sector in fostering risk diversification and providing liquidity within an economy.

The short run coefficients are consistent with the earlier findings. Business cycle volatility and volatility persistence are responsive to trade openness given the positive elasticities although estimates under the PMG are slightly significant. Government expenditure and foreign aid do not matter in macroeconomic fluctuations in both the short and long run. While short run coefficient of private credit is negative in all the models, interestingly, it is only significant at the business cycle volatility under the PMG estimation. Further findings from our study reveal no short run threshold effect on finance–volatility nexus when we control for shocks. Thus, in the short term excessive development of the financial sector does not have attendant magnifying effect on volatility. A possible conjectural explanation for this is that in the short term, firms may be below their (optimal) solvency level and further increase in credit does not come at a cost to stability.

Consistent with long run finding, both shocks to inflation and terms of trade have amplifying business cycle volatility in the short run. While real shock also significantly increases long run volatility, the effect of monetary shock on short term volatility persistence is insignificant at conventional levels suggesting in the short run, shocks to inflation do not matter in volatility persistence. As regards to their respective elasticities, while both shocks propagate short run business cycle volatility, the coefficients of real shocks are larger. There is evidence that volatility driven by external factors and terms of trade in particular, generates internal volatility, especially in developing countries (see [46,47]).

Juxtaposing with the long run evidence proposes that, while monetary shocks have large magnifying effect on volatility at the long run business cycle their effect in the short run is minuscule. More specifically, the impact of inflation fluctuation on the long run business cycle volatility is almost twice as the short run gleaning from the PMG estimation. The reverse however holds for real shocks. We turn to the channels through which financial sector impact on volatility. Consistent with earlier evidence, our findings reveal that even in the short term, financial development dampens (magnifies) the effect of real shocks (monetary shocks) on the components of volatility. Relative to the MG where the effect is almost 1:1, the PMG estimation shows that the dampening effects of financial sector are consistently higher than its propagation effect in the short run. Overall, the findings reveal that improvement (deterioration) in terms of trade allays (amplifies) both volatility components.

As expected, the error correction terms are negative and significant in the estimation approaches suggesting convergence. More specifically, the coefficients reveal that, the system instantaneously reverts to its long run equilibrium following a shock that diverts its path away from steady state. The validity of the long run homogeneity restriction across countries, and hence the efficiency of the PMG estimator over the MG, is assessed by the Hausman test. While the MG allows the long run coefficients to vary across countries, the PMG estimator on the other hand equates the long run elasticities by assuming homogeneous effects across the countries under consideration. Our Hausman tests of model difference accept the null hypotheses of the homogeneity restriction on the regressors in the long run given the low (high) chi-square (p-values) test statistics. This evidence projects the PMG as a more efficient and consistent estimator relative to the MG.

4.2. Sensitivity analysis

In this section, we determine the robustness of the results using (i) different measures of financial development and (ii) estimation approach. Specifically, we proxy financial development using domestic credit to the private sector which refers to financial resources provided to the private sector by financial corporations, such as through loans, purchases of non-equity securities, and trade credits and other accounts receivable, that establish a claim for repayment. Relative to private credit, domestic credit is a broader measure of financial development and extend to capture credit provided by non-bank institutions. With regard to the estimation approach, we use [48] system generalized methods of methods (GMM) to examine the relationships among financial development, shocks and growth volatility components. The system GMM estimator combines moment conditions for the model in first-differences with those for the models in levels. The lags of the exogenous variables are used as instruments in the estimation in addition to the lags of the dependent variable—volatility components. Efficiency of the GMM estimates is contingent on the validity of the instruments which we examine using serial correlation and Sargan's tests for over-identifying restriction. Our tests Sargan's tests endorse the validity of the instruments given our failure to reject the null hypotheses of over-identifying restrictions suggesting the validity of the instrument. The tests for second order-correlation [AR(2)] also failed to reject the no serial correlation of order two at conventional levels. These findings provide coherent and consistent estimates on the back of valid instruments.

Apart from their robustness to heteroskedasticity and non-normality of the disturbances, the main advantage of this approach is the use of instrumental variables which helps in addressing biases stemming from reverse causality. Table 4

Table 4
Financial development, shocks, volatility components and transmission channels.
Source: Authors' estimations.

Variables	Dependent variables			
	Levels		Transmission channels	
	Business cycle volatility [Column 1]	Long run volatility [Column 2]	Business cycle volatility [Column 3]	Long run volatility [Column 4]
Lagged dependent	−1.501** (2.111)	−1.984* (0.005)	−3.673** (0.039)	−3.807* (0.002)
Trade openness	0.092** (2.149)	0.077* (3.104)	0.064** (2.301)	0.059*** (1.910)
Government expenditure	0.051 (1.422)	0.025 (1.333)	0.040*** (1.921)	0.037 (1.600)
Foreign aid	0.094 (1.115)	0.101 (1.410)	0.077 (1.094)	0.071 (1.251)
Financial development	−0.056** (2.017)	−0.043** (2.281)	−0.045** (2.173)	−0.017* (3.744)
Financial development_Sq	0.084* (3.901)	0.061* (3.102)	0.059** (2.321)	0.021** (2.001)
Shocks:				
Monetary shock	0.066*** (1.968)	0.056** (2.110)	0.049** (2.091)	0.029** (2.311)
Real shock	0.041* (3.620)	0.031** (2.362)	0.046** (2.210)	0.027*** (1.980)
Transmission channels:				
FD × Monetary shock	–	–	0.093** (2.227)	0.063* (3.340)
FD × Real shock	–	–	−0.023* (3.901)	−0.019* (3.411)
Diagnostics				
Observations	806	806	806	806
Country fixed effects	Yes	Yes	Yes	Yes
Time effects	Yes	Yes	Yes	Yes
Number of countries	23	23	23	23
AR(2) *z*-value [*p*-value]	−1.793[0.410]	−1.012[0.318]	−1.827[0.251]	−1.146[0.409]
Threshold value	33.33%	35.25%	38.14%	40.48%
Sagan chi-square [*p*-value]	16.321 [1.000]	21.544 [1.000]	17.901 [1.000]	22.535 [1.000]
Wald chi-square [*p*-value]	0.001	0.000	0.000	0.000

Notes: Values in ( ) are the test statistic. All variables are in logs. The threshold value is the value after which financial development exacerbates volatility.
* Denote significance at 1%.
** Denote significance at 5%.
*** Denote significance at 10%.

presents findings on the relationships among financial development, shocks and volatility components relying on a panel dataset spanning 1980–2014.

Results from Table 4 above show that the respective lagged dependent volatility component is included as an explanatory variable and coefficients of the initial volatilities are negative and significant suggesting that the countries eventually converge over time towards a common level volatility. Our findings from the GMM are qualitatively similar to findings from the PMG and MG estimations in terms of direction of effect but not the level of magnitude and significance. For instance, trade openness positively and significantly influence both business cycle and long run volatilities although the former effect is larger. This finding is consistent with our earlier evidence and suggest that a percentage-point increase in international openness magnifies volatility at the business cycle and long run component by 9.2% and 7.7% respectively (Columns 1 and 2). These findings remain robust to controlling for transmissions as trade openness amplifies volatilities albeit reduced magnitudes and impact on long run volatility is slightly significant. The main conclusion is that small economies like those in SSA are more volatile when they are more open. Government expenditure does not influence volatility (Columns 1 and 2). However, its effect on business cycle volatility is positive and slightly significant in the model containing the transmission channels (Column 3) suggesting that impact of fiscal policy on macroeconomic fluctuations

is not robust and model-specific. Foreign aid does not appear to matter in volatility. Consistent with our earlier findings, the coefficient of financial development – proxied by domestic credit to GDP ratio – is robustly negative and significant revealing that higher development of the financial sector is associated with reduced volatilities at both the business cycle and long run components whether or not we control for pass-through effect of finance to volatility. Our further findings suggest such effect is intrinsically non-linear. For instance, the quadratic term of financial development is also robust and positive confirming threshold effect in finance–volatility nexus. These thresholds are estimated to range between 33.33% and 40.48% and are relatively higher compared to the PMG and MG estimations. Specifically, financial development dampens business cycle fluctuations up to a point where domestic credit to GDP ratio ranges between 33.33% and 38.14% and begins to magnify volatility at the business cycle when domestic credit exceeds these thresholds. The inflection point at which further increases in financial development exacerbates volatility persistence is relatively higher and estimated at 35.25%–40.48%. Countries where these thresholds were exceeded over the sample period 1980–2014 were South Africa and Mauritius. The main conclusion drawn is that the amount of available domestic credit is necessary for reduction in economic fluctuations.

The effect of monetary and real shocks in volatility process is positive and robust albeit reduced coefficients at the long run components. Specifically, a unit-percentage rise in shock to inflation magnifies business cycle and long run volatilities by 6.6% and 5.6% respectively. These effects remain significant when transmission channels are controlled for, although coefficients produced here are relatively smaller. The results reported are similarly to real shock–volatility nexus where shock to terms of trade amplifies both volatility components. However, elasticity of volatility components to changes in shock is higher when the economy is hit by monetary shock relative to real shock. Even under real shock, effects are subdued when we include transmissions. These findings collaborate with our earlier findings and imply a magnifying impact of real and monetary shocks thus revealing the importance of inflation and terms of trade fluctuations in the volatility process. Controlling for channels does not alter the results. Specifically, we found that financial development even when proxied by domestic credit reduces both volatility at the business cycle and persistence by dampening the positive effect of terms of trade shock while heightening the pass-through effect of monetary shock to growth fluctuations (Column 3 and 4). More specifically, an improvement in financial development from its 25th percentile (9.77%) to the median value (15.34%) exacerbates business cycle and long run fluctuations by 0.053 and 0.036 percentage-points respectively through its effect on inflation shock. Conversely, when domestic credit to GDP ratio increases from the 25th percentile to the median, volatilities at the business cycle and long run decreases by 0.013 and 0.011 percentage-points respectively via terms of trade.

5. Policy implications and recommendations

The results herein are of crucial importance to policy makers in terms of highlighting the optimal level of financial development to ensure that minimal growth fluctuations are maintained through the financial sector. We discuss key policy implications arising from the findings. We have found that while financial development dampens business cycle volatility, its effect on the long run volatility is insignificant.

International trade policies are also often linked to the economic fluctuations although it is generally difficult to assess the overall contribution of an economy's openness to its business cycle and long run volatilities. On one hand, by lowering barriers to trade, economies become more susceptible to shocks. However, trade with other countries can also potentially decrease the effect of domestic shocks by "exporting" some of their destabilizing effects to the economy's trading partners. Our findings however document the latter effect as output fluctuations rise following de-restrictions on trade. In fact, the magnifying role of trade openness is more pronounced in the short run business cycle component. Perhaps in the long run, economies are better able to develop strong mitigating effects.

The standard Keynesian view highlights government's consumption expenditure as critical antidote to fluctuations. We however do not find the role of fiscal policy in smoothening volatility in the case of SSA as effects of government size are largely insignificant suggesting that using fiscal policy to stabilize the economy will be ineffective. Our evidence highlights the role of financial sector in economic fluctuations given the negative relationship between financial development and business cycle volatility. The implication is that, developed financial systems are more capable of screening potential borrowers, which should reduce the likelihood that projects with greater probability of failure are financed. Thus, smoother business cycle is associated with financial systems characterized by reduced credit markets imperfections. From a theoretical perspective, the "balance sheet view" postulates that developed financial sectors improves the ability of financial institutions to gather, process and screen information about debtors thus reducing agency costs and minimizing credit market imperfections. Because external shocks to economic activity are magnified by asymmetric information, lowering the level of market imperfections is therefore expected to reduce volatility at the business cycle (see [49,50]).

In other words, financial development indicators may reveal the level and effects of financial imperfections arising from information asymmetries and/or other structural bottlenecks. Thus, an adverse relationship between volatility and financial development is generally consistent with the hypothesized impact of asymmetric information in amplifying business cycles. Indeed, the idea is that factors motivating the growth-enhancing effects of financial development should also lead to smoother fluctuations. As financial systems become more capable of cream-skimming, the likelihood of financing bad projects is reduced thus taming economic activity fluctuations. The overall result emerging from the cross-country regressions is that economic fluctuations are less volatile with developed financial sector. However, unbridled financial development associated with over developed financial sector is not healthy for growth as financial development–volatility nexus is nonlinear. Specifically, financial development decreases business cycle volatility up to a point beyond which

further increases in financial sector size magnifies volatility. While developed financial systems tend to be more efficient in identifying those firms that wrongly overstate the extent of their liquidity, over developed financial sector is often associated with excessive credit growth to the private sector thus permitting the financing of unsustainable projects magnifying business cycle volatility. Thus, knowledge of firms' solvency needs and proper supervision is needed to ensure that credit advanced is consistent with the solvency needs of firms because in the end, the behaviour of those firms are constrained by the financial sectors' unwillingness to lend. Business cycles will therefore be smoother following financial institutions' effective use of available information about potential borrowers and cash flow needs. Encouraging financial development for its own sake may be counter-productive. Policy makers should rather seek to strengthen the appropriate size and quality of finance rather than expanding the financial sector.

Our cross-country evidence suggests that volatility caused by monetary shocks is more important and persistent than that caused by real shocks and financial underdevelopment of SSA. If domestic output fluctuations were primarily driven by external shocks, then our evidence would have supported the real business cycle view that economic fluctuations are largely influenced by world productivity disturbances. Rather, our findings show that factors driving fluctuations are largely internal. More importantly, the rather high inflationary pressures as experienced in majority of the countries under consideration exacerbates macroeconomic instability and volatility.

With regard to transmission channels, higher levels of financial development magnify the impact of monetary shocks proxied by shock to inflation. Rising inflation reduces consumers' spending as this erodes purchasing power thus lowering firms' revenues, net worth and creditworthiness. These increases the agency costs and the external financing premium magnifies shocks to economic activity by amplifying spending, borrowing and investment vagaries. The magnifying effect of financial sector is however higher at the short run business cycle relative to the long run. This notwithstanding, financial development dampens the positive effect of real shocks on volatility components. Apart from relaxing credit constraints for firms, deepening the financial sector may also help mitigate real shock to economic activity as it promotes diversification thereby lowering risk.

At the policy level, strengthening supervision, including cross-border oversight is crucial in examining the right levels of finance necessary to falter economic fluctuations. Because enforcement of prudential standards remains lax, providing supervisors with more enforcement power and strengthening the capacity of central banks should be the core in financial sector development process. Moreover, leveraging on the importance of monetary shocks in propagating volatility, it is important for central banks like those in SSA to adopt inflation targeting approach as it sets institutional commitment to price stability as the primary long run goal of monetary policy. Given the obvious likelihood that countries in SSA are frequently hit by shocks that could distort inflation from its long run path, missing the inflation targets may be untenable. What is needed by policy makers is to focus on short to medium term to ensure that deviations are brought on track and inflation converges to a trajectory consistent with price stability and financial sector development.

6. Conclusion

The aim of this study has been to examine the role of financial sector development in volatility as well as channels through which finance impacts on volatility relying on annual data for 23 countries in SSA spanning 1980–2014. Earlier studies attempting to assess finance–growth volatility nexus have not been informative as they fail to decompose the various components of volatility understanding that financial development affects volatility through its different components. This paper quantified the relative importance of a monetary and real shocks and how finance affects business cycle and long run volatilities through its interaction with broad set of shocks. Our overall finding supports the salutary effect of finance reducing business cycle volatility in SSA albeit not monotonically. The implication is that while well-developed financial sector dampens volatility at the business cycle, unbridled financial development may also magnify fluctuations. However, effect of financial development on long run fluctuation is only imaginary. Further findings show that while monetary shocks have large magnifying effect on volatility at the long run business cycle, their effect in the short run is minuscule. The reverse however holds for real shocks. Our main conclusion is that irrespective of the component, volatility caused by monetary shocks is more persistent than those caused by real shocks and financial underdevelopment. This notwithstanding, our evidence reveals that irrespective of the time horizon, financial development dampens (magnifies) the effect of real shocks (monetary shocks) on the components of volatility although the dampening effects are huge in the short run. These findings are robust to financial development proxy and estimation approach and reaffirm our evidence on finance–volatility nexus. To smooth volatility, the study recommends central banks to strengthen their supervision role in aligning financial development towards a path consistent with long run growth while adopting an inflation targeting approach to falter monetary shocks.

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Appendix

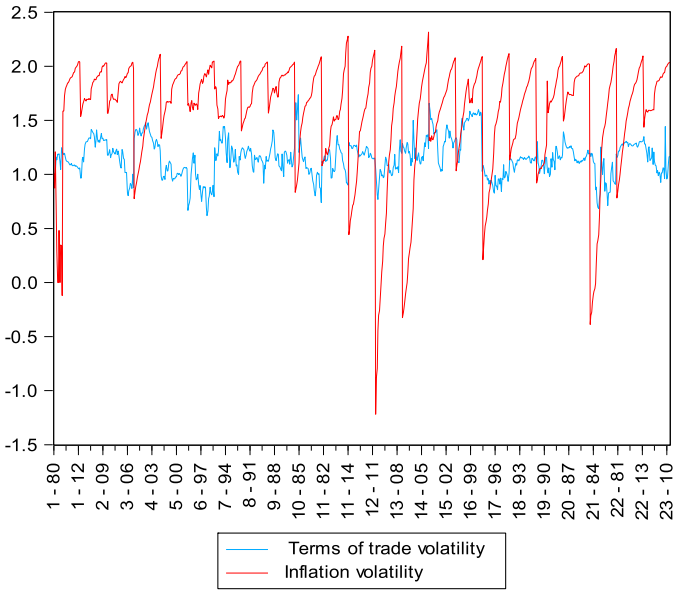

Fig. 1. Real and monetary shocks.
Source: Authors' construct.

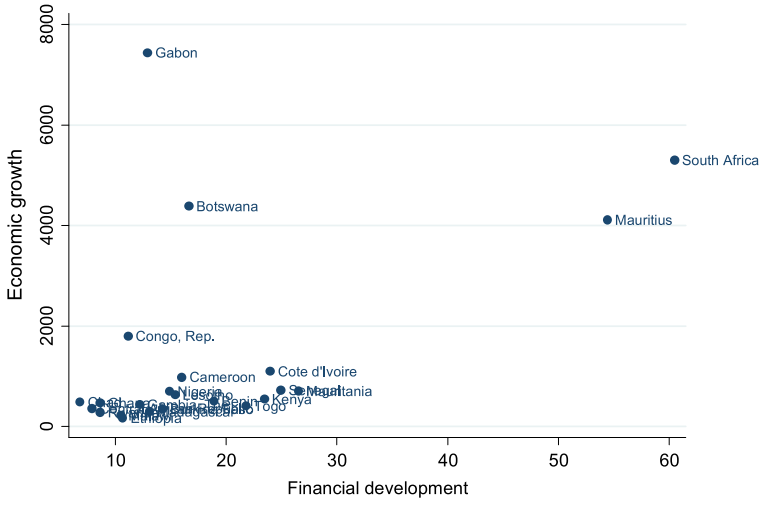

Fig. 2. Financial development and economic growth.
Source: Authors' construct using WDI.

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