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Openness and the Effects of Monetary Policy in Africa*

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Abstract

This paper investigates the relationship between a country's openness to trade and the effects of monetary policy on output growth and inflation in Africa. Theory suggest that monetary policy effectiveness is influenced by the degree of openness to international trade. We apply standard panel data techniques to annual data from the period 1990–2015 for a panel of 37 African countries, and find a strong significant relationship between openness and monetary policy effectiveness in Africa. The empirical results indicate that the effects of monetary policy on output growth and inflation increases and decreases respectively with higher levels of trade openness. Therefore, monetary authorities should place emphasis on the level of openness when designing their choice of optimal monetary policy.

Keywords: Openness; Monetary policy; Africa.

JEL Classification: C33; E52; F41; O55

*The views expressed here are those of the authors and not of their institutional affilliations. The usual disclaimer applies.

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1 Introduction

As a useful tool for macroeconomic stabilization, monetary policy is important for the purpose of influencing the direction of economic activities. Through various monetary transmission channels, monetary authorities can use monetary policy to either expand or contract activities in the real economy depending on the desired macroeconomic objective. For instance, economic theory predicts that monetary expansion often raises both the output and price levels respectively, while monetary tightening have the opposite effects. However, the debate on the effects of monetary policy often requires a better understanding of the underlying factors that influences its effectiveness. In this paper, we consider one of such factors namely, the degree of trade openness, as a plausible determinant that could affect monetary policy effectiveness on output growth and inflation in African countries.

In open economy monetary economics, a country's domestic currency – the nominal exchange rate – is a defining variable in the monetary transmission process, such that its potential adjustments has implication for the design and conduct of monetary policy. For instance, international trade activities often have an exchange rate pass-through effect in an economy. This effect is expected to be larger in more open economies and with flexible exchange rate, but small in less open economies and with fixed exchange rate. Thus, the degree of an economy's openness is a state variable which influences the effectiveness of monetary policy on output and prices. Theoretically, monetary expansion is supposed to have a weaker effect on output level and a strong inflationary effect in more open economies. In other words, for a given change in money supply in a more open economy, output level will be small or negative whereas inflation will increase. The intuition is straightforward: for more open economies, expectation of a domestic currency depreciation triggers higher wage demand which steepen the aggregate supply such that monetary expansion will be more reflected in prices and less on output (Karras, 1999).[1]

Another perspective to the debate focuses on the openness-inflation relationship resulting from the absence of precommitment in monetary policy. Building on Romer (1993), the argument is that unanticipated monetary expansion induces real exchange rate depreciation which, in turn, generates an inefficiently high inflation. For more open economies faced with a steeper Phillips curve – that is, a larger output-inflation trade-off – the incentive to engage in expansionary monetary policy diminishes with with a higher degree of openness. Consequently, inflation is expected to be lower in more open economies (see also, Lane,

[1]Ths is the supply-side effect of monetary expansion in a more open economy. The opposite will be true for the less open economy. On the other hand, the demand-side effect would depend on the nature of expenditure-switching between domestic and foreign goods. However, the maintained assumption is that the demand effect will be similar for both a more open and relatively closed economies.

1997). Put differently, the short-term benefit of an unanticipated monetary expansion is negatively correlated with the degree of openness such that less expansion will, on average, lower inflation in more open economies. In all, the theoretical expectation is that the effect of monetary policy on output diminishes with openness; while in the case of inflation, the relationship can be positive or negative to indicate that prices increases or decreases respectively with an increasing level of openness.

Using annual data for a panel of 37 African countries from the period 1990 to 2015, this paper estimate the relationship between openness and the effects of monetary policy on output and inflation. The aim is to examine whether these theoretical effects can be empirically detected for African countries. A number of reasons motivate our focus on Africa. First, there is a dearth of empirical evidence on the impact of openness on the effects of monetary policy in Africa. Attempts at investigating the underlying factors that could influence monetary policy effectiveness in the continent have so far concentrated on the role of excess liquidity (Saxegaard, 2006), and financial sector development (Effiong et al., 2017). Hence, there is need to investigate whether openness to trade influences the effects of monetary policy on output and prices in Africa. Second, regional integration has been intensified in the continent over the last three decades with the formation of regional economic communities through the initiatives of Regional Trade Agreements (RTAs). Recent efforts include the Tripartite Free Trade Area (TFTA) and the proposed Continental Free Trade Area (CFTA) which are designed to deepen intra-regional trade and investment for both employment creation and growth (AEO, 2016).[2] These initiatives are expected to enhance regional economic co-operation and financial market integration among Africa countries, the realization of which, would lead to the birth of an African Monetary Union. The success of such macroeconomic interdependence among African economies will no doubt have implications for the design and conduct of monetary policy in the continent. In all, our empirical results indicate that the effects of monetary policy on output growth and inflation increases and decreases respectively with higher level of openness to international trade. Hence, the level of openness influences monetary policy effectiveness in stabilizing output and prices in African countries.

Our paper is related to several recent contributions to the debate on the relationship between openness and the effects of monetary policy on output and prices. Karras (1999) used annual data from 1953-1990 period for a panel of 38 countries and finds evidence in support of the theory: the more open an economy, the smaller (larger) the output (inflation) effects of monetary policy shocks. Karras (2001) reports similar evidence for the relationship

[2]The TFTA is the largest free trade zone in Africa, and it comprise of member countries of the Common Market for Eastern and Southern Africa (COMESA), East African Community (EAC) and the Southern African Development Community (SADC). Meanwhile, the objective of CFTA is that it will evolve into an African Economic Community that would reduce the overlaps between Africa's regional communities.

between openness and the effects of monetary policy on output for eight countries (Australia, Canada, Germany, Italy, Japan, South Africa, the U.K. and the U.S.A.) using quarterly data from the period 1960 to 1994. Berument and Doğan (2003) find evidence on the importance of openness for monetary policy effectiveness in Turkey. Their results show that a change in money supply will lead to a smaller output, whereas the impact on inflation is a parallel to Romer's hypothesis that demonstrates a negative relationship with the level of openness.

Berument et al. (2007) analyzed the effect of openness on the effectiveness of monetary policy on output growth and inflation for a group of 29 countries using quarterly data from 1957:2 to 2003:4 on the basis of country-by-country estimations. They find variations in the effect of openness on monetary policy effectiveness on output and inflation across countries. Thus, they argued that difference in countries' characteristics such as exchange rate regimes, the degree of central bank independence, exposure to international financial crises, terms-of-trade shocks, different monetary policy stance, and the degree of capital controls could affect the monetary policy transmission process, and thereafter influence the relationship between openness and monetary policy effectiveness. Isik and Acar (2006) find empirical support for theoretical relationship that changes in higher degree of openness will dampen the output effects of changes in money supply. Further evidence show that monetary policy has limited effect in developing countries than in developed economies.

Cwik et al. (2011) evaluates the role of trade integration – or openness – for monetary policy transmission in a medium-scale New Keynesian Dynamic Stochastic General Equilibrium (DSGE) model with strategic complementarities in price setting. Their counterfactual simulations show that openness affects monetary transmission significantly, and that the effect of a monetary policy shock on inflation and output tend to increase with openness. Ćorić et al. (2016) investigates the impact of economic openness and the responsiveness of output to a domestic monetary policy shock for a sample of 48 developing and developed countries. Using the structural vector autoregression (SVAR) model, the effects of a monetary policy shock on output for each country is estimated, and subsequently used in a cross-section regression to investigate the sources of cross-country variation in the output response to a monetary policy shock. Their findings indicate that monetary policy shock has on average a larger effect on output with a higher openness to trade. Other important factors include, the exchange rate regime and banking sector development.

The balance of this paper is organized as follows. Section 2 discusses the empirical methodology and data. Section 3 presents the empirical results with a number of robustness checks. Section 4 concludes with the policy implications.

2 Empirical Methodology and Data

Following the empirical approach of previous studies (see e.g. Karras, 1999, 2001), we examine the relationship between a country's degree of trade openness and the effectiveness of monetary policy in Africa. In the absence of precise measurement for monetary policy effectiveness,[3] we instead use standard panel data models for macroeconomic analysis to gauge the direct and interaction effects of trade openness and monetary policy on output and inflation. The direct impact of money growth on output growth and inflation are specified as follows:

$$\Delta y_{j,t} = \beta_0 + \sum_{i=1}^{Q} \beta_i^y \Delta y_{j,t-i} + \sum_{i=0}^{R} \beta_i^{oil} \Delta OIL_{j,t-i} + \sum_{i=0}^{S} \beta_{i,j,t}^m \Delta m_{j,t-i} + u_{j,t}^y \tag{1}$$

$$\Delta p_{j,t} = \gamma_0 + \sum_{i=1}^{Q} \gamma_i^p \Delta p_{j,t-i} + \sum_{i=0}^{R} \gamma_i^{oil} \Delta OIL_{j,t-i} + \sum_{i=0}^{S} \gamma_{i,j,t}^m \Delta m_{j,t-i} + u_{j,t}^p \tag{2}$$

where j and t indexes over countries and time respectively. Δy is the output growth rate , Δp is the inflation rate, Δm is the money growth rate, and ΔOIL is the growth rate of real oil prices which is included as a proxy for possible supply shocks. As in Karras (1999), Eqs. (1) and (2) represents the reduced-form expressions for output growth and inflation with β's and γ's as coefficients; and $u_{j,t}^y$ and $u_{j,t}^p$ as the output and inflation shocks respectively, which are modelled as $u_{j,t}^y = u_j^y + w_{j,t}^y$ and $u_{j,t}^p = u_j^p + w_{j,t}^p$, where u_j^ys and u_j^ps denote country fixed effects.

To capture the impact of trade openness on the effects of money growth on output and inflation, an interaction term for trade openness is incorporated in the following manner:

$$\beta_{j,t-1}^m = \vartheta_i^m + \vartheta_i^o open_{j,t-1} \tag{3}$$

$$\gamma_{j,t-1}^m = \phi_i^m + \phi_i^o open_{j,t-1} \tag{4}$$

where $open_{j,t}$ is a measure of trade openness in country j at time t, while ϑs and ϕs are the parameters. Incorporating Eq.(3) into Eq.(1), gives the output equation which measures the effect of trade openness on the money growth and output growth relationship; while the inflation equation is obtained by incorporating Eq.(4) into Eq.(2), to measure the effect

[3]The literature on monetary policy and the monetary transmission mechanism uses the VAR methodology to derive impulse response functions (IRFs) of real macroeconomic variables such as output and prices following an unanticipated monetary policy shock. Its methodological shortcomings include: identification of the intermediate target of monetary, and exogenous monetary policy shocks through various identification schemes such as Choleski decompositions or non-recursive (simultaneous) identification.

of trade openness on the money growth and inflation relationship. The resulting equations are as follows:

$$\Delta y_{j,t} = \beta_0 + \sum_{i=1}^{Q} \beta_i^y \Delta y_{j,t-i} + \sum_{i=0}^{R} \beta_i^{oil} \Delta OIL_{j,t-i} + \sum_{i=0}^{S} (\vartheta_{i,j,t}^m \Delta m_{j,t-i} + \vartheta_i^{om} open_{j,t-1} \Delta m_{j,t-1}) + u_{j,t}^y \tag{5}$$

$$\Delta p_{j,t} = \gamma_0 + \sum_{i=1}^{Q} \gamma_i^p \Delta p_{j,t-i} + \sum_{i=0}^{R} \phi_i^{oil} \Delta OIL_{j,t-i} + \sum_{i=0}^{S} (\phi_{i,j,t}^m \Delta m_{j,t-i} + \phi_i^{om} open_{j,t-1} \Delta m_{j,t-1}) + u_{j,t}^p \tag{6}$$

where $open_{j,t-1}\Delta m_{j,t-1}$ is the interaction between trade openness and money growth on output growth and inflation respectively, while all other variables remain as earlier defined.

The overall strength of monetary policy on output growth and inflation in Eqs. (5) and (6) is easily identified from the the sum of the money growth coefficients, $\sum_{i=0}^{S} \vartheta_i^m$ and $\sum_{i=0}^{S} \phi_i^m$ respectively. For example, monetary policy shocks (say an increase in Δm_{t-i}) that leads to larger values in these coefficients would imply a larger overall effect of monetary policy on output growth and inflation, whereas the reverse for smaller values would suggest a dampening effect of monetary policy. Moreover, our main focus centres on the coefficients of the interaction term between trade openness and money growth ($\sum_{i=0}^{S} \vartheta_i^{om}$, $\sum_{i=0}^{S} \phi_i^{om}$), which measures the impact of trade openness on money growth to output and inflation respectively. Specifically, if the coefficient sign is positive (negative), then this would imply that more openness to trade will strengthen (weaken) the effects of monetary policy on output growth and inflation. Meanwhile, the magnitude of the impact will depend on the coefficient size. For theoretical consistent, we expected a negative relationship between trade openness and the effects of monetary policy on output; and a positive relationship between trade openness and monetary policy effects on inflation *á la* Karras (1999) or a negative relationship to fit with Romer's expectation about the policy choice of monetary authorities.

Annual data of 37 African countries over the period 1990 to 2015 is used for the empirical analysis, where countries and time span are selected subject to data availability. The datasets are retrieved mainly from the World Bank's *World Development Indicators* and the IMF's *International Financial Statistics* except for oil prices which is sourced from the U.S. Energy Information Administration website. Our main variables for the analysis include, broad money supply (M2), consumer price index (CPI), real gross domestic

product (GDP), real oil prices (OIL), and measures of trade openness (*open*). The first three variables are expressed in growth rates (i.e., annual percentage change) as follows respectively:

$$\begin{aligned}\Delta m_{j,t} &= (M2_{j,t} - M2_{j,t-1})/M2_{j,t-1} \\ \Delta p_{j,t} &= (CPI_{j,t} - CPI_{j,t-1})/CPI_{j,t-1} \\ \Delta y_{j,t} &= (GDP_{j,t} - GDP_{j,t-1})/GDP_{j,t-1}\end{aligned}$$

We use as a measure of trade openness the sum of import and export as a fraction of GDP: $OPEN_{j,t} = (IM_{j,t} + EX_{j,t})/GDP_{j,t}$. Alternatively and for robustness checks, imports as a fraction of GDP ($IM_{j,t}/GDP_{j,t}$) is also used. Lastly, we deflate U.S. dollar oil prices by the U.S. implicit price deflator to obtain the real oil prices.

Table 1 shows the list of the 37 African economies and their country averages over the sample period for each measure of inflation, output growth, money growth and the trade openness indices. As evident from Table 1, substantial variation exist across countries. For instance, average annual output growth rate ranged from a minimum of 0.49% in Central African Republic to a maximum of 21.071% in Equatorial Guinea; while the average annual rate of inflation ranged from 2.694% in Senegal to 40.278% in Sudan. Also, the annual money growth ranged from 6.607% in the Central African Republic to 46.648% in Guinea Bissau. In addition, trade openness has also varied substantially across African countries. The sum of imports and exports as a fraction of GDP (i.e. $open_1$) ranged from a minimum of 27.067% in Sudan to a maximum of 232.051% in Equatorial Guinea. Similar pattern is observed for import as a fraction of GDP (i.e. $open_2$). Moreover, the panel average of 72.187% and 40.969% for both measures of trade openness respectively, indicate that African countries have become more open to international trade with a high import component within the sample period. Therefore, these variation in trade openness should lead to considerable differences in the monetary policy effects on output and inflation across these countries. Also, whether trade openness exert a significant influence on the monetary policy effects on output growth and inflation in line with theoretical prediction remains an empirical question within the context of African countries which this paper intends to validate in the next section.

Table 1: Sample means (1990-2015)

Country	Δy	Δp	Δm	$open_1$	$open_2$
1. Algeria	2.885	9.464	16.085	60.097	26.245
2. Benin	4.520	4.414	13.105	57.179	33.832
3. Botswana	4.664	8.905	16.144	96.811	45.662
4. Burkina Faso	5.361	3.178	12.147	41.399	27.514
5. Burundi	1.225	11.448	15.639	36.295	28.319
6. Cabo Verde	7.059	3.642	13.838	90.147	61.003
7. Cameroon	2.604	3.668	7.079	42.158	21.462
8. Central African Rep.	0.490	5.627	6.607	41.385	24.906
9. Chad	5.969	4.241	12.351	67.955	40.635
10. Congo, Rep.	3.188	5.155	13.275	126.902	55.335
11. Cote d'Ivoire	2.554	3.903	9.275	78.372	35.559
12. Egypt	4.224	9.178	14.043	49.708	27.710
13. Equatorial Guinea	21.071	5.845	27.306	232.051	147.607
14. Gabon	2.455	2.928	9.069	87.611	31.984
15. Gambia	3.366	5.895	15.948	63.467	38.049
16. Ghana	5.490	20.527	34.369	78.559	46.520
17. Guinea-Bissau	2.285	16.029	46.648	50.427	32.998
18. Kenya	3.612	12.688	16.876	56.426	32.365
19. Madagascar	2.372	12.415	16.706	62.037	37.195
20. Malawi	4.293	21.616	29.776	61.172	36.935
21. Mali	4.439	3.038	11.525	54.765	32.435
22. Mauritius	4.671	6.041	12.623	120.909	63.367
23. Morocco	3.979	2.710	10.192	63.781	35.557
24. Mozambique	7.467	18.782	29.832	71.369	49.641
25. Niger	3.601	2.975	9.816	47.929	30.162
26. Nigeria	5.651	18.886	27.389	56.375	23.165
27. Rwanda	5.519	7.434	16.254	36.409	26.832
28. Senegal	3.535	2.694	9.717	66.457	39.674
29. Seychelles	3.818	5.063	12.019	141.851	81.978
30. Sierra Leone	2.822	21.420	27.908	53.455	33.629
31. South Africa	2.446	7.3637	12.656	52.886	25.843
32. Sudan	4.966	40.278	40.445	27.067	15.543
33. Swaziland	3.887	8.092	12.599	131.740	71.779
34. Tanzania	5.319	13.598	22.753	47.462	30.013
35. Togo	2.773	4.357	9.551	86.673	50.413
36. Tunisia	4.106	4.222	9.793	92.644	48.656
37. Uganda	6.652	10.330	24.841	38.979	25.333
Panel	4.469	9.407	17.465	72.187	40.969

Note: Δp is the CPI inflation rate (%), Δy is the real growth rate of GDP (%), Δm is the growth rate of M2 (%), $open_1$ is the sum of import and export as a fraction of GDP, and $open_2$ is the ratio of import to GDP.

3 Empirical Results

3.1 Main results

Table 2 reports the estimate between the degree of openness and the effects of monetary policy on output growth and inflation. This comprise of the estimates for output growth and inflation regressions respectively with the definition of openness as the ratio of sum of import and export to GDP. For sake of parsimony and less model overparametization, only the first lag of output growth and inflation as well as the first lag and contemporaneous level of oil price growth are included in both output growth and inflation regressions respectively. Moreover, we experiment with a richer lag structure of money growth and its interaction with openness to trade. Lastly, panel fixed effects technique is used to estimate all regression equations. This is because of its consistency under plausible assumptions in the presence of lagged terms of the dependent variable (see Judge et al., 1985).

As shown from Table 2, output growth and inflation exhibit some persistence as indicated by the statistically significantly positive AR(1) term and is precisely estimated in all regressions; higher oil prices are shown to impact output positively at both contemporaneous level and first lag, whereas its affect inflation negatively across the inflation regressions with variation in statistical significance. As for the impact of money growth, though the signs and statistical signficance of the estimated coefficients of Δm_{t-i} do change across both output growth and inflation regressions, the cumulative effect of the sum of money growth coefficients (i.e. $\sum_{i=0} \vartheta_i^m$, $\sum_{i=0} \phi_i^m$) indicate the overall strength of monetary expansion, and monetary policy in general. For output growth, the sum of Δm_{t-i} (i.e. $\sum_{i=0} \vartheta_i^m$) are negative and statistically indifferent from zero except when up to two lags of money growth is included in the output growth regressions. This suggest that monetary expansion leads to a reduction in the output level. In the short run, monetary expansion often leads to a temporary increase in output level. But, a backward reversal is possible in the long run following adjustments of the monetary authority. Hence, output level may fall, on average, in the long run. Meanwhile, the absence of statistical significance across the regressions is consistent with the money neutrality proposition in the long run. On the other hand, the estimated coefficients for the sum of the interactive terms of money growth and trade openness (i.e. $\sum_{i=0} \vartheta_i^{om}$) is positive – although quantitatively small – and statistically significant. This means that there is positive relationship between openness and the effect of monetary policy on output growth such that a given change in money supply increases the output level in a more open economy. In other words, openness to trade enhances the effectiveness of monetary policy on output level. While the evidence is in contrast to theoretical prediction of a negative relationship, recent studies show that trade openness

Table 2: Openness and monetary policy effectiveness in Africa: main results

Dependent variable: real output growth Δy_t					Dependent variable: inflation rate Δp_t				
Variables	(1)	(2)	(3)	(4)	Variables	(5)	(6)	(7)	(8)
Δy_{t-1}	0.190**	0.153***	0.0857***	0.0701**	Δp_{t-1}	0.549***	0.495***	0.457***	0.431***
	(2.463)	(2.893)	(3.461)	(2.688)		(13.788)	(15.877)	(14.880)	(11.784)
Δoil_t	0.0191***	0.0151	0.0137	0.0123	Δoil_t	-0.0214*	-0.0210	-0.0188	-0.0174
	(2.854)	(1.482)	(1.463)	(1.372)		(-1.715)	(-1.685)	(-1.499)	(-1.386)
Δoil_{t-1}	0.0210*	0.0144**	0.0123**	0.0097	Δoil_{t-1}	-0.0177	-0.0222*	-0.0250*	-0.0229*
	(1.958)	(2.180)	(2.297)	(1.668)		(-1.552)	(-1.880)	(-1.981)	(-1.878)
Δm_t	-0.0031	0.0536**	0.0913***	0.101***	Δm_t	0.237***	0.2504***	0.2332***	0.192***
	(-0.098)	(2.100)	(3.468)	(3.476)		(4.168)	(5.199)	(5.794)	(4.798)
Δm_{t-1}		-0.0997***	-0.1194**	-0.121**	Δm_{t-1}		0.113***	0.0931*	0.0962
		(-2.969)	(-2.597)	(-2.655)			(4.369)	(1.762)	(1.685)
Δm_{t-2}			-0.0729***	-0.0627***	Δm_{t-2}			0.0431***	0.0231
			(-5.287)	(-3.387)				(2.949)	(0.703)
Δm_{t-3}				0.0080	Δm_{t-3}				0.0349***
				(0.394)					(3.407)
$\Delta m_t open_t$	0.0006***	-0.0002	-0.0004***	-0.0005***	$\Delta m_t open_t$	-0.0007**	-0.0006**	-0.0005**	-0.0003
	(3.113)	(-1.178)	(-3.419)	(-3.466)		(-2.065)	(-2.157)	(-2.172)	(-1.183)
$\Delta m_{t-1} open_{t-1}$		0.0018***	0.0017***	0.0018***	$\Delta m_{t-1} open_{t-1}$		-0.0006*	-0.0005	-0.0006
		(5.952)	(4.822)	(4.987)			(-1.829)	(-1.391)	(-1.509)
$\Delta m_{t-2} open_{t-2}$			0.0013***	0.0016***	$\Delta m_{t-2} open_{t-2}$			-0.0002	-0.0001
			(11.206)	(9.651)				(-0.738)	(-0.438)
$\Delta m_{t-3} open_{t-3}$				0.0002**	$\Delta m_{t-3} open_{t-3}$				-0.0003***
				(2.531)					(-2.847)
Constant	2.733***	2.407***	2.620***	1.561**	Constant	0.922	-0.150	0.0372	0.650
	(8.460)	(6.999)	(5.256)	(2.380)		(1.269)	(-0.181)	(0.036)	(0.503)
$\sum_{i=0} \vartheta_i^m$	-0.0031	-0.0461	-0.101*	-0.0749	$\sum_{i=0} \phi_i^m$	0.237***	0.3634***	0.3694***	0.3462***
	(-0.098)	(-1.124)	(-1.916)	(-1.672)		(4.168)	(5.401)	(4.415)	(3.261)
$\sum_{i=0} \vartheta_i^{om}$	0.0006***	0.0016***	0.0026***	0.0031***	$\sum_{i=0} \phi_i^{om}$	-0.0007***	-0.0012**	-0.0012**	-0.0013**
	(3.113)	(5.499)	(6.147)	(6.870)		(-2.065)	(-2.615)	(-2.333)	(-2.174)
N	925	925	888	851		925	925	888	851
adj. R^2	0.068	0.164	0.212	0.276		0.472	0.496	0.473	0.401

Note: $\sum_{i=0}^{S} \vartheta_i^m$ and $\sum_{i=0}^{S} \phi_i^m$ are the sum of the money growth coefficients (Δm_{t-i}) in the output and inflation equation respectively; $\sum_{i=0}^{S} \vartheta_i^{om}$ and $\sum_{i=0}^{S} \phi_i^{om}$ are the sum of the coefficients of the interaction terms ($fd_t \Delta open_t$) in the output and inflation equation respectively with their Wald test F-statistics in the parenthesis. t-statistics in parentheses. ***, **, * indicates 1%, 5% and 10% significance level.

contributes to economic growth in the region (see e.g. Brueckner and Lederman, 2015).

As for the case of inflation, the sum of the estimated coefficients of money growth (i.e. $\sum_{i=0} \phi_i^m$) are positive and statistically significant across the various lag structure in the regressions. The size of these coefficients are quantitatively higher that than those of the output growth regressions, and is consistent with economic theory prediction that monetary expansion is associated with higher inflation. However, the sum of the coefficients for the interactive term of money growth and trade openness (i.e. $\sum_{i=0} \phi_i^{om}$) is negative and statistically significant. This means that inflation decreases in a more open economy with monetary expansion, which fits with Romer's expectations on the openness-inflation nexus. In other words, there is a negative relationship between the degree of openness and the effect of monetary policy on inflation. Therefore, openness to trade dampens the effectiveness of monetary policy on inflation. Our findings is consistent with Berument and Doğan (2003), and the recent evidence from Lin et al. (2017) that trade openness restraints inflation in Sub-Saharan Africa.

Some explanations for our empirical results are worth highlighting. First, higher imports increases the output level while decreasing prices due to substitution effects (Berument and Doğan, 2003).[4] Africa's export to the world market is mainly dominated by primary products such as oil, metals etc., and in turn, their import of intermediate goods (including raw materials) tend to contribute towards output expansion in both the tradable and non-tradable sectors. With regional integration, increased trade volume can accelerate output and productivity. Second, openness is likely to reduce inflation through its positive effect on output in accordance with the 'new growth theory' (Jin, 2000; Ashra, 2002). This link could operate through: (i) increased efficiency which is likely to reduce costs through changes in composition of inputs procured domestically and internationally; (ii) better allocation of resources; (iii) increased capacity utilization; and (iv) an increase in foreign investment. Accordingly, Cukierman et al. (1992) shows that free trade facilitates convergence in prices of traded goods across small open economies. Therefore, a lower degree of price distortion is expected in outward-looking countries. Moreover, inflation – a kind of tax on domestic currency - is expected to be low in more open economies because of the relative ease in converting domestic and foreign currencies (Zakaria, 2010). Lastly, the existence of imperfect competition and nominal price rigidity in the non-tradable sector can lead to an inverse relationship between openness and inflation (Lane and Gian, 2006).

[4]Note that the openness measure increases due to higher imports.

3.2 Robustness checks

As a first step towards validating the above findings, we vary the data frequency to address possible long-term business cycle effects in the data. Thus, a three-year non-overlapping country averages for each variable is used to re-estimate the output growth and inflation regressions with the same lag structure as in the above analysis. Hence, the sample is split into eight data points of the three-year non-overlapping periods which are 1990-1992, 1993-1995, 1996-1999, 2000-2002, 2003-2005, 2006-2009, 2010-2012, and 2013-2015. The results of the regressions is presented in Table 3.

Across both output growth and inflations regressions in Table 3, the sum of the money growth coefficients has a negative and positive effect on output growth and inflation respectively. Statistical significance is observed for these coefficients in the output growth regression with the various lag structure used, and the exception for the inflation regressions is when the third-lag of money growth is included in the estimation. However, this evidence does not invalidate the above main findings that monetary expansion reduces output while increasing inflation. In fact, it reaffirms the importance of monetary policy as a useful tool for macroeconomic stabilization particularly in the short run. As for the sum of the interactive term between money growth and openness, the findings of a positive and negative relationship between openness and the effect of monetary policy on output and inflation respectively remains unchanged. As an economy becomes more open, monetary expansion increases output level and reduces inflation. Therefore, accounting for possible long-term business cycle effects in the data does not change the reported findings in Table 2 despite the variation in statistical significance.

For further sensitivity checks, an alternative measure of openness namely, the ratio of import to GDP ($open_2$) is used. Table 4 presents the estimates for both output growth and inflation regressions. Looking through the results, the use of import as a fraction of GDP to measure openness does not change the main results but instead it reaffirms our findings. The signs for the sum of money growth coefficients is negative for output growth and is statistically significant except at its contemporaneous level in Column (1). Meanwhile, the effect is positive and statistically significant across the inflation regressions. Thus, monetary expansion reduces output and increases inflation. On the other hand, the sum of the interactive term between money growth and openness is positive for output growth and negative for inflation with all estimates across both output growth and inflation regressions being statistically significant at the various lag structure. Therefore, our findings that output level increases while inflation decreases following monetary expansion in a more open economy is robust with an alternative measure of openness.

Table 3: openness robust result with 3-year averages

Dependent variable: real output growth Δy_t					Dependent variable: inflation rate Δp_t				
Variables	(1)	(2)	(3)	(4)	Variables	(5)	(6)	(7)	(8)
Δy_{t-1}	0.0444	-0.119	-0.0484	-0.00427	Δp_{t-1}	0.216***	0.182**	0.193***	-0.0120
	(1.239)	(-0.798)	(-0.819)	(-0.032)		(2.827)	(2.047)	(2.896)	(-0.115)
Δoil_t	0.0366**	0.0341*	0.0211	0.0324*	Δoil_t	-0.121***	-0.120***	-0.00871	-0.000413
	(2.247)	(1.953)	(1.297)	(1.945)		(-3.976)	(-3.886)	(-0.361)	(-0.018)
Δoil_{t-1}	0.00557	0.0222	0.0139	0.0357**	Δoil_{t-1}	-0.112*	-0.111*	0.0295	0.0282
	(0.369)	(1.219)	(0.943)	(2.141)		(-1.984)	(-1.887)	(0.735)	(0.739)
Δm_t	-0.206**	-0.188***	-0.177***	-0.0663	Δm_t	0.518***	0.476***	0.0741	-0.0467
	(-2.539)	(-3.205)	(-4.584)	(-1.417)		(4.272)	(3.848)	(1.308)	(-0.848)
Δm_{t-1}		-0.0135	0.0152	-0.0574	Δm_{t-1}		0.0893**	0.0503	0.0614
		(-0.397)	(0.406)	(-1.401)			(2.402)	(0.653)	(0.880)
Δm_{t-2}			0.0223*	-0.0375	Δm_{t-1}			0.0551	-0.0328
			(1.915)	(-0.825)				(1.020)	(-0.403)
Δm_{t-3}				0.0237	Δm_{t-3}				-0.0265
				(1.145)					(-0.549)
$\Delta m_t open_t$	0.00347***	0.00328***	0.00318***	0.00137***	$\Delta m_t open_t$	-0.0014**	-0.00109	0.0000457	0.000697
	(5.652)	(6.156)	(8.682)	(3.066)		(-2.091)	(-1.633)	(0.086)	(1.101)
$\Delta m_{t-1} open_{t-1}$		0.00129**	0.00121**	0.00139**	$\Delta m_{t-1} open_{t-1}$		-0.000689***	-0.000261	-0.000217
		(2.298)	(2.677)	(2.705)			(-2.999)	(-0.356)	(-0.515)
$\Delta m_{t-2} open_{t-2}$			-0.00109***	0.000302	$\Delta m_{t-2} open_{t-2}$			0.0000458	-0.0000221
			(-7.395)	(0.728)				(0.087)	(-0.031)
$\Delta m_{t-3} open_{t-3}$				-0.000306	$\Delta m_{t-3} open_{t-3}$				0.0000483
				(-0.929)					(0.129)
Constant	3.258***	2.372***	2.955***	2.815**	Constant	1.088	0.945	1.792**	6.012***
	(4.452)	(3.017)	(3.880)	(2.705)		(0.587)	(0.516)	(2.683)	(3.067)
$\sum_{i=0} \vartheta_i^m$	-0.206***	-0.2015**	-0.1395***	-0.1375*	$\sum_{i=0} \phi_i^m$	0.518***	0.565***	0.1794***	-0.0446
	(-2.539)	(-2.596)	(-2.727)	(-1.811)		(4.272)	(4.264)	(3.331)	(-0.291)
$\sum_{i=0} \vartheta_i^{om}$	0.00347***	4.57×10^{-3}***	0.0033***	0.0027***	$\sum_{i=0} \phi_i^{om}$	-0.0014**	-0.0018**	-1.69×10^{-4}	5.07×10^{-4}
	(5.652)	(4.329)	(6.655)	(5.548)		(-2.091)	(-2.353)	(-0.495)	(0.643)
N	259	259	222	185		259	259	222	185
adj. R^2	0.453	0.532	0.692	0.475		0.410	0.414	0.237	0.016

Note: $\sum_{i=0}^{S} \vartheta_i^m$ and $\sum_{i=0}^{S} \phi_i^m$ are the sum of the money growth coefficients (Δm_{t-i}) in the output and inflation equation respectively; $\sum_{i=0}^{S} \vartheta_i^{om}$ and $\sum_{i=0}^{S} \phi_i^{om}$ are the sum of the coefficients of the interaction terms ($fd_t \Delta open_t$) in the output and inflation equation respectively with their Wald test F-statistics in the parenthesis. t-statistics in parentheses. ***, **, * indicates 1%, 5% and 10% significance level.

Table 4: Robustness with alternative openness measure – Import/GDP ($open_2$)

Dependent variable: real output growth Δy_t					Dependent variable: real output growth Δp_t				
Variables	(1)	(2)	(3)	(4)	Variables	(5)	(6)	(7)	(8)
Δy_{t-1}	0.184**	0.121***	0.0280	0.00473	Δp_{t-1}	0.553***	0.500***	0.466***	0.440***
	(2.422)	(3.005)	(1.070)	(0.131)		(13.338)	(14.894)	(13.887)	(11.728)
Δoil_t	0.0198***	0.0139	0.0141	0.0133	Δoil_t	-0.0225*	-0.0226*	-0.0201	-0.0183
	(3.000)	(1.329)	(1.480)	(1.522)		(-1.767)	(-1.789)	(-1.586)	(-1.453)
Δoil_{t-1}	0.0228*	0.0173**	0.0152***	0.0127**	Δoil_{t-1}	-0.0184	-0.0240*	-0.0270**	-0.0249*
	(1.987)	(2.468)	(2.791)	(2.032)		(-1.613)	(-2.024)	(-2.112)	(-2.001)
Δm_t	-0.0109	0.0634***	0.0817***	0.0945***	Δm_t	0.221***	0.233***	0.222***	0.184***
	(-0.407)	(3.086)	(3.967)	(4.202)		(4.498)	(5.561)	(6.111)	(5.139)
Δm_{t-1}		-0.128***	-0.120***	-0.117***	Δm_{t-1}		0.0994***	0.0756	0.0777
		(-5.352)	(-3.109)	(-3.367)			(3.828)	(1.629)	(1.550)
Δm_{t-2}			-0.0689***	-0.0582***	Δm_{t-2}			0.0330***	0.0084
			(-5.131)	(-3.301)				(2.775)	(0.302)
Δm_{t-3}				0.0076	Δm_{t-3}				0.0384***
				(0.479)					(3.200)
$\Delta m_t opn_t$	0.0012***	-0.0004***	-0.000624***	-0.0008***	$\Delta m_t open_t$	-0.0007**	-0.0006**	-0.0006**	-0.0002
	(7.258)	(-3.686)	(-5.938)	(-6.681)		(-2.228)	(-2.066)	(-2.093)	(-0.933)
$\Delta m_{t-1} opn_{t-1}$		0.0033***	0.0029***	0.0030***	$\Delta m_{t-1} open_{t-1}$		-0.0006	-0.0005	-0.0006
		(16.638)	(8.856)	(9.105)			(-1.489)	(-1.267)	(-1.375)
$\Delta m_{t-2} opn_{t-2}$			0.0018***	0.0024***	$\Delta m_{t-2} open_{t-2}$			-3.9×10^{-6}	0.0001
			(14.564)	(17.539)				(-0.019)	(0.466)
$\Delta m_{t-3} opn_{t-3}$				1.86×10^{-4}**	$\Delta m_{t-3} open_{t-3}$				-4.31×10^{-4}***
				(2.072)					(-2.949)
Constant	2.791***	2.827***	3.179***	2.248***	Constant	0.891	-0.239	-0.0441	0.509
	(9.913)	(8.643)	(5.094)	(3.709)		(1.170)	(-0.261)	(-0.040)	(0.362)
$\sum_{i=0} \vartheta_i^m$	-0.0109	-0.0644*	-0.1073**	-0.0727*	$\sum_{i=0} \phi_i^m$	0.221***	0.3326***	0.3303***	0.3089***
	(-0.407)	(-2.014)	(-2.432)	(-1.906)		(4.498)	(5.486)	(4.415)	(3.186)
$\sum_{i=0} \vartheta_i^{om}$	0.0012***	0.0029***	0.0041***	0.0048***	$\sum_{i=0} \phi_i^{om}$	-0.0007**	-0.0011***	-0.0011**	-0.0012**
	(7.258)	(13.499)	(12.566)	(14.029)		(-2.228)	(-2.719)	(-2.356)	(-2.175)
N	925	925	888	851		925	925	888	851
adj. R^2	0.079	0.237	0.279	0.351		0.471	0.492	0.468	0.396

Note: $\sum_{i=0}^{S} \vartheta_i^m$ and $\sum_{i=0}^{S} \phi_i^m$ are the sum of the money growth coefficients (Δm_{t-i}) in the output and inflation equation respectively; $\sum_{i=0}^{S} \vartheta_i^{om}$ and $\sum_{i=0}^{S} \phi_i^{om}$ are the sum of the coefficients of the interaction terms ($fd_t \Delta open_t$) in the output and inflation equation respectively with their Wald test F-statistics in the parenthesis. t-statistics in parentheses. ***, **, * indicates 1%, 5% and 10% significance level.

4 Conclusion

This paper investigates whether the effects of monetary policy on output growth and inflation in Africa is influenced by the degree of openness to international trade. Theory predicts that a monetary expansion is suppose to dampen output level in a more open economy, while the effect on inflation is ambiguous as it could be positive *á la* Karras (1999), or negative in support of Romer's prediction. Annual data for a panel of 37 Africa countries over the period 1990 to 2015 is used to estimate the empirical accuracy of these theoretical predictions.

Our empirical results show that openness to international trade is an important determinant of monetary policy effectiveness in Africa. Specifically, openness enhances the effect of monetary policy on output. Put differently, the effect of a monetary expansion accelerates output growth as the level of openness increases. This is contrary to the theory prediction of a negative relationship. On the other hand, openness dampens the effect of monetary policy on inflation. This suggest a negative relationship openness and the effect of a given change in money supply on inflation, such that an increase in openness leads to a decline in inflation. Hence, the result supports Romer's prediction on the openness and inflation relationship.

In the light of these empirical results, a direct policy implication is that monetary authorities in African countries should keep watch on the level of openness when designing their choice of optimal monetary policy. This is paramount since the level of openness is positively related with output level, while negatively related to inflation. Therefore, monetary authorities should act parallel to Romer's prediction on openness and monetary policy. Otherwise, the effects of monetary expansion will be absorbed by inflation. Furthermore, current efforts at regional integration should be deepened and sustained, since it encourages capital and labour mobility, enhanced trade volume, and promotes technological innovation. Also, possible concerns among African countries on the potential loss of monetary policy independence should be weighed in terms of the stabilization benefit of output and prices in the proposed African Monetary Union.

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