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On the Drivers of Inflation in Sub-Saharan Africa

by Anh D.M. Nguyen, Jemma Dridi, Filiz D. Unsal and Oral H. Williams

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African Department

On the Drivers of Inflation in Sub-Saharan Africa

Prepared by Anh D.M. Nguyen, Jemma Dridi, Filiz D. Unsal and Oral H. Williams[1]

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Abstract

The perception that inflation dynamics in Sub-Saharan Africa (SSA) are driven by supply shocks implies a limited role for monetary policy in influencing inflation in the short run. SSA's rapid growth, its integration with the global economy, changes in the policy frameworks, among others, in the last decade suggest that the drivers of inflation may have changed. We quantitatively analyze inflation dynamics in SSA using a Global VAR model, which incorporates trade and financial linkages among economies, as well as the role of regional and global demand and inflationary spillovers. We find that in the past 25 years, the main drivers of inflation have been domestic supply shocks and shocks to exchange rate and monetary variables; but that, in recent years, the contribution of these shocks to inflation has fallen. Domestic demand pressures as well as global shocks, and particularly shocks to output, however, have played a larger role in driving inflation over the last decade. We also show that country characteristics matter—the extent of oil and food imports, vulnerability to weather shocks, economic importance of agriculture, trade openness and policy regime, among others, help in explaining the role of shocks.

JEL Classification Numbers: C32, E31, E52, F40

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Author's E-Mail Address: anhndm88@gmail.com, jdridi@imf.org, dunsal@imf.org,and owilliams2@imf.org

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I. INTRODUCTION

Inflation and inflation volatility in Sub-Saharan Africa (SSA) have been gradually declining. In the 1980s, monetary policy was subordinated to the objective of financing large fiscal deficits in the region. This led to high inflation and, in combination with fixed exchange rates, overvalued real exchange rates (Berg et al., 2015). From the mid–1980s to the late 1990s countries began reform programs, often with exchange rate unifications and movement toward more market-determined exchange rates, notable reductions in central bank financing of government and financial liberalizations. With substantial debt relief and a favorable external environment, fiscal discipline was reestablished in many parts of SSA.
This provided support for money-based disinflation programs to bring down inflation to single digits (or near single) by the late 1990s in the context of higher economic growth and higher international reserves, in line with the experience in other developing countries (Table 1).

Table 1. Inflation in SSA[1]. 1985–1995, 1995–2005, 2005–2013

	1985-1995			1995-2005			2005-2013		
	(percent)		(Percent of GDP)	(percent)		(Percent of GDP)	(percent)		(Percent of GDP)
	Inflation	Growth	International Reserves	Inflation	Growth	International Reserves	Inflation	Growth	International Reserves
Mean	28.7	2.5	6.8	14.9	4.4	9.0	10.1	5.8	14.0
Median	16.5	3.5	4.6	13.3	4.2	8.8	9.2	5.5	12.7
Standard Deviation	18.8	4.5	3.0	10.6	4.3	3.1	5.1	2.6	2.8
Mean (Developing countries)	402.9	0.8	2.3	32.7	4.3	9.9	8.7	5.3	58.3

[1]Excluding countries with exchnage rate pegs according to 2012 AREAER.

Source: World Economic Outlook Database. Annual data (y/y growth) is used to calculate inflation and GDP growth. International reserves are expressed as a percent of GDP

Nevertheless, managing inflation pressures remains one of the biggest challenges for policymakers in the region. Headline inflation is considerably more volatile in SSA relative to other regions given high share of food in the CPI and more volatile relative food prices (mostly owing to unstable agricultural production). Output and inflation tend to be negatively correlated as a result, making the tradeoff between inflation and output stability potentially more severe. The prevalence of supply-side shocks also reduces the ability of monetary policy in influencing inflation in the short run. At the same time, the weaker relationship between money and inflation over time, at least in countries with low to moderate inflation, limits the role of money targeting regimes—commonly observed in SSA—in delivering low inflation and managing inflation expectations (IMF 2014).

Against this background, an important consideration for policymakers is to identify forces that drive inflation dynamics across the region. Central banks in SSA have been at times rather passive in episodes of rising inflation on the premise that inflationary pressures derive largely from temporary supply shocks and/or from imported sources. It is implicit in these

arguments that policymakers can clearly identify whether inflation is driven by supply and demand pressures as well as the extent to which these pressures are caused by foreign versus domestic sources. However, identifying the relative contributions of different factors to inflation is complicated by the fact that these factors usually coexist and interact.

To determine the relative contributions of various factors to inflation it is thus necessary to conduct an empirical analysis which explicitly incorporates domestic, regional, and global factors, and their interactions. This paper examines the relative impacts of supply shocks and demand shocks, as well as their origins in terms of foreign and domestic sources. In our framework, supply factors comprise commodity prices and inflation, while demand factors comprise shocks to money supply, nominal interest rates, exchange rates and real activity. This paper improves on other studies by being the first in the literature on drivers of inflation in SSA that (i) explicitly accounts for trade and financial linkages among economies such that impacts of regional and global shocks on domestic economies, as well as for those of individual economies to conditions overseas are considered; and (ii) studies how the drivers have changed over time.

Using pooled data estimated VAR estimations for developing countries over the period 1964–1998, Loungani and Swagel (2001) find that inflation persistence pays a predominant role, accounting about 70 percent of variation in inflation in SSA. The role of money growth and exchange rate changes, however, are lower than that in developing countries as a whole. They also find that commodity shocks are somewhat important in those economies, explaining about 10 percent of inflation variations. Barnichon and Peiris (2008) estimate an augmented (closed economy) Phillips curve for 19 African countries in 1960–2003, and find that both the output gap and the real money gap played an important role in inflation dynamics.[2]

There are also some other studies on a group of or individual countries in SSA. Focusing on CEMAC, Portillo (2009) and Baldini and Poplawski-Ribeiro (2011) showed that fiscal shocks and imported commodity prices are the main drivers of inflation for these countries.[3] Durevall and Sjö (2012) investigate inflation dynamics in Kenya for the sample 1999–2010 and Ethiopia for 1999–2011 and find that world food prices and exchange rates have long run effects, while money growth and agricultural supply shocks have short-to-medium run effects on inflation. Simpasa et al. (2011) look inflation dynamics in four East African countries (Ethiopia, Kenya, Tanzania and Uganda) over 1961–2010, and show that money supply, world oil prices and world food prices are significant factors in driving inflation. Durevall,

[2] Thornton (2008) employs panel data analysis to examine the long-run relationship between money-inflation for 36 African countries during 1960–2007. He finds a weak (strong) long-run relation between money growth and inflation for countries with low (high) inflation of low (high) money growth. This type of work, however, is not very helpful in understanding dynamics of inflation over a meaningful policy horizon.

[3] See Fielding, Lee, and Shields (2005) for an analysis of inflation persistence in CFA countries.

Loening, and Birru (2013) also find the importance of international food and goods prices in the long-run in the case of Ethiopia.

We present a two-step empirical analysis of inflation dynamics in SSA.[4] First, we identify the nature and origin of inflationary pressures for the economies in the region using the Global VAR (GVAR) framework proposed by Pesaran, Schuermann, and Weiner (2004). We estimate the GVAR model for 65 countries, including 33 SSA countries, from 1988 to 2013 (first quarter). Second, we examine how the inflationary processes in the region have changed over time by estimating the model for two sub-samples, 1988–98 and 1999–2013.

We find that domestic supply shocks and shocks to exchange rate and monetary variables have been the most important factor in driving inflation in SSA over the last 25 years. We show that country characteristics matter—the extent of oil and food imports, vulnerability to weather shocks, economic importance of agriculture, trade openness and policy regime, among others, have a role in explaining the role of various shocks in driving inflation. We also find that the drivers of inflation in SSA have changed significantly over the last decade. The role of domestic supply shocks and shocks to exchange rate and monetary variables has declined across the region, and the role of foreign factors has risen in most countries reflecting greater integration of the region to the world economy, and large oil and foods shocks since then. These changes in the importance of different shocks in driving inflation are broadly consistent with the changes observed in other developing countries.

The rest of the paper is organized as follows. Section II describes the GVAR methodology and discusses data issues. Section III presents the empirical results, and Section IV concludes.

II. Data and Methodology

A. Data

The GVAR model developed in this paper cover 65 countries. In estimating the model, 8 Euro area are grouped together (based on their PPP-GDP weights), as well as 14 CFA countries, and the remaining 33 countries are modeled individually (Table 2). The GVAR model, therefore, contains 35 countries/regions. Given the focus of our work, we center the presentation of the results for non-CFA countries.

[4] In this paper, we use SSA countries to refer to countries that are not in the African Financial Community (CFA) franc zone (NCFA-SSA), excluding South Africa. However, we present the results for CFA member countries in Box 1.

Table 2 Countries and regions in the GVAR model

NCFA-SSA	CFA-SSA	Rest of the World	
Botswana	Benin	USA	**Asia**
Burundi	Burkina Faso	Canada	Australia
Cabo Verde	Cameroon	UK	New Zealand
Ethiopia	Central AFR Rep	Sweden	Japan
Gambia	Chad	Switzerland	Korea
Ghana	Congo Rep	Norway	Singapore
Kenya	Cote d'ivory		China
Madagascar	Equatorial	**Euro Area**	India
Malawi	Gabon	Germany	Indonesia
Mauritius	Guinea-Bissau	France	Malaysia
Nigeria	Mali	Italy	Thailand
Rwanda	Niger	Spain	Philippines
Seychelles	Senegal	Netherlands	
Sierra Leone	Togo	Belgium	**Others**
South Africa		Austria	Turkey
Swaziland		Finland	Saudi Arabia
Tanzania			
Uganda		**Latin America**	
Zambia		Brazil	
		Mexico	
		Argentina	
		Chile	
		Peru	

The model is estimated over the period 1998:1–2013:1 using quarterly data. For each country, we include consumer prices index (CPI), nominal effective exchange rate (NEER), broad money (M), nominal interest rates (either deposit or discount rates) (NIR) and real GDP (RGDP); as well global oil and food prices.

The main data sources for all the variables for SSA are the IMF's International Financial Statistics (IFS) and World Economic Outlook (WEO). For other countries and regions, CPI, RGDP, and NIR are borrowed from Smith and Galesi (2014) dataset except for the NEER and broad money, which are from the IFS. GDP in Purchasing Power Parity terms in current international dollars are from the World Bank's World Development Indicators database and they were used to compute the aggregation weights (PPP-GDP) for regions and for variables in the model. Trade weights are calculated using the data from the IMF's Direction of Trade statistics.[5]

[5] Trade shares are used as weights to construct country-specific foreign variables which sum up to one for a given country. In cases where the number of country-specific variables is not the same across countries, zero-weights are assigned to countries for which the corresponding domestic variables are not available, and then rescaled the weights to sum up to one. To calculate the PPP-GDP weights in the aggregation of countries into a group, we first averaged the GDP in PPP terms over the period 2000–10 for each country in the group and then compute the share of each.

Before estimating the model, we conduct unit root and cointegration tests to identify and take account of long term relationships between macroeconomic variables for each country.[6] Unit root tests are conducted using both the traditional Dickey-Fuller (DF) tests and the weighted symmetric (WS) estimation of ADF type regressions introduced by Park and Fuller (1995). The test results show that nominal interest rate, oil and food prices are I (1). Meanwhile, CPI, the nominal effective exchange rate, real GDP and broad money appear to be I(2) in most countries, so the first difference was used instead, in line with the literature.[7]

B. Methodology: GVAR Approach

Global vector autoregressions (GVARs) have proven to be a useful tool in exploring the various channels and interlinkages through which shocks are transmitted and how countries are interconnected through spillovers. This ‘‘integrated’’ feature of GVAR allows for the identification of inflation sources as supply or demand factors, which can be of domestic, regional or global origin. The framework also allows for the construction and use of weakly exogenous country-specific foreign variables and global variables in the estimation of individual country models. In other words, trade and financial linkages are exploited to allow for a coherent inclusion of national models into a global model that deals with the ‘‘curse of dimensionality problem’’ associated with large models.

The GVAR approach can be regarded as a two-step approach. In the first step, small scale country-specific models are estimated conditional on the rest of the world. These models feature domestic variables and (weighted) cross section averages of foreign variables, which are treated as weakly exogenous (or long-run forcing). In the second step, individual country models are stacked and solved simultaneously as one large global VAR model.

We briefly summarize the GVAR framework drawing on Dees et al. (2007) and Galesi and Lombardi (2009). Suppose there are $N+1$ countries in the global economy, indexed by $i = 0, 1, \dots, N$. The aim is to model a number of country-specific macro-economic variables collected in the vector $\mathbf{x}_{it}$, over time, $t = 1,2,..,T$ and across the $N+1$ countries. Denote the observed global factors by the $m_d \times 1$ vector $\mathbf{d}_t$, and the unobserved global factors by the $m_f \times 1$ vector $\mathbf{f}_t$, and assume that[8]

$$\mathbf{x}_{it} = \delta_{i0} + \delta_{i1}t + \mathbf{\Gamma}_{id}\mathbf{d}_{\mathrm{t}} + \mathbf{\Gamma}_{\mathrm{if}}\mathbf{f}_{\mathrm{t}} + \xi_{it} \text{ for } i = 0,1,2,\dots,N;\ t = 1,2,..,T, \qquad (1)$$

[6] Note that, unit root and cointegration properties between variables can be accommodated by allowing for the global and idiosyncratic factors to have unit roots. We will talk about the issue in more detail in the next section.

[7] We also run the estimations using real GDP in levels for a robustness check. The results are available upon request.

[8] As mentioned in Dee et al. (2007), dynamic factor models can be also accommodated by incorporating lagged values of $\mathbf{d}_t$ and $\mathbf{f}_t$ as additional factors via suitable extensions of $\mathbf{d}_t$ and $\mathbf{f}_t$.

where $\mathbf{\Gamma}_{\mathrm{i}} = (\mathbf{\Gamma}_{\mathrm{id}}, \mathbf{\Gamma}_{\mathrm{if}})$ is the $k_i \times m$ matrix of factor loadings, ξ_{it} is a $k_i \times 1$ vector representing the country-specific effects involving lagged values of $\boldsymbol{x}_{it}$ or country-specific dummy variables, and δ_{i0} and δ_{i1} are the coefficients of the deterministic time trend.

Dee et al. (2007) provide a theoretical framework where the GVAR is derived as an approximation to a global unobserved common factor model. In a nutshell, when *N* is relatively large, unobserved factors can be proxied by the cross section averages of country-specific variables and the observed common effects. Thus, we can derive the individual country VARX*($\mathrm{p_i}, \mathrm{q_i}$) model from the country factor model in (1) as follows:

$$\Phi_{\mathrm{i}}(\mathrm{L}, \mathrm{p_i})\mathbf{x}_{\mathrm{it}} = \mathbf{a}_{\mathrm{i0}} + \mathbf{a}_{\mathrm{i1}}\mathrm{t} + \mathbf{\Upsilon}_{\mathrm{i}}(\mathrm{L}, \mathrm{q_i})\mathbf{d}_{\mathrm{t}} + \mathbf{\Lambda}_{\mathrm{i}}(\mathrm{L}, \mathrm{q_i})\mathbf{x}^{*}_{\mathrm{it}} + \mathbf{u}_{\mathrm{it}}, \tag{2}$$

for $i = 0,1,2,\ldots,N;\ t = 1,2,..,T$, where $\mathbf{a}_{i0}$ and $\mathbf{a}_{i1}$ are the coefficients of the deterministic trend time trend; $\mathbf{x}^{*}_{\mathrm{it}}$ is a set of foreign-specific variables which is computed by $\mathbf{x}^{*}_{\mathrm{it}} = \sum_{\mathrm{j=0}}^{\mathrm{N}} \mathrm{w_{ij}}\mathbf{x}_{\mathrm{jt}}$ with $\mathrm{w}_{ii} = 0$ and $\sum_{j=0}^{N} \mathrm{w_{ij}} = 1$, where $\mathrm{w_{ij}}$ is the trade share of country *j* in total trade of country *i*; $\Phi_{\mathrm{i}}(\mathrm{L}, \mathrm{p_i})$, $\mathbf{\Lambda}_{\mathrm{i}}(\mathrm{L}, \mathrm{q_i})$, and $\mathbf{\Upsilon}_{\mathrm{i}}(\mathrm{L}, \mathrm{q_i})$ are the matrix lag polynomial of the associated coefficients;[9] $\mathbf{u}_{\mathrm{it}}$ is a $k_i \times 1$ vector of idiosyncratic, serially uncorrelated, country-specific shocks with

$$\mathbf{u}_{\mathrm{it}} \sim \mathrm{iid}\ (0, \mathbf{\Sigma}_{\mathrm{ii}}), \tag{3}$$

for $i = 0,1,2,\ldots,N$ and $t = 1,2,..,T$, where $\mathbf{\Sigma}_{\mathrm{ii}}$ is nonsingular.

The idiosyncratic shocks $\mathbf{u}_{\mathrm{it}}$ are correlated across countries/regions. Therefore, the GVAR model allows for interdependence through three channels: (i) the contemporaneous interrelation of domestic variables $\mathbf{x}_{\mathrm{it}}$ with country-specific foreign variables $\mathbf{x}^{*}_{\mathrm{it}}$ and with their lagged values, (ii) the dependence of domestic variables $\mathbf{x}_{\mathrm{it}}$ on global variables $\mathbf{d}_{\mathrm{t}}$ and their associated lagged values, (iii) the contemporaneous dependence of shocks in country *i* on the shocks in country *j*.

We estimate (2) in its error-correction form for all countries and then recover the corresponding VARX* models. To solve the GVAR model for the world as a whole, we start from the estimated country-specific VARX*($\mathrm{p_i}, \mathrm{q_i}$) models:[10]

[9] The lag orders, $\mathrm{p_i}$ and $\mathrm{q_i}$, are respectively related to the domestic variables and to both the foreign-variables and the global variables. Following Dee et al. (2007), for each country i, they are selected by the Akaike information criterion, where the maximum lag order is set equal to 2 due to data limitations.

[10] The rank of the cointegrating space for each country is computed using Johansen's trace and maximal eigen value statistics. The final selection of the rank orders is determined by the trace statistic, because it is known to have better power properties than the maximal eigenvalue statistic in small samples.

$$\mathbf{x}_{it} = \mathbf{a}_{i0} + \mathbf{a}_{i1}t + \Phi_{i1}\mathbf{x}_{i,t-1} + \cdots + \Phi_{ip_i}\mathbf{x}_{i,t-p_i} + \mathbf{\Lambda}_{i0}\mathbf{x}^*_{it} + \mathbf{\Lambda}_{i1}\mathbf{x}^*_{i,t-1} + \cdots + \mathbf{\Lambda}_{iq_i}\mathbf{x}^*_{i,t-q_i} + \mathbf{u}_{it}. \quad (4)$$

Define $\mathbf{z}_{it}$ by $\mathbf{z}_{it} = \begin{pmatrix}\mathbf{x}_{it}\\ \mathbf{x}^*_{it}\end{pmatrix}$,

Then we can use the so called link matrices W_i, defined by the trade weights w_{ij} to obtain the identity: $\mathbf{z}_{it} = \mathbf{W}_i\mathbf{x}_t$ where $\mathbf{x}_t = (\mathbf{x}'_{0t}, \mathbf{x}'_{1t}, \ldots, \mathbf{x}'_{Nt})'$ which has $k = \sum_{i=0}^{N} k_i$ variables**.** Express (4) in terms of $\mathbf{z}_{it}$ and assume for simplicity of exposition that $p_i = q_i$, we obtain

$$\mathbf{G}_{i0}\mathbf{z}_{it} = \mathbf{a}_{i0} + \mathbf{a}_{i1}t + \mathbf{G}_{i1}\mathbf{z}_{i,t-1} + \cdots + \mathbf{G}_{ip_i}\mathbf{z}_{i,t-p_i} + \mathbf{u}_{it}, \quad (5)$$

with $\mathbf{G}_{i0} = (\mathbf{I}_{k_i}, -\mathbf{\Lambda}_{i0})$ and $\mathbf{G}_{ij} = (\Phi_{ij}, \mathbf{\Lambda}_{ij})$, for $j = 1, \ldots, p_i$. Using the identity that $\mathbf{z}_{it} = \mathbf{W}_i\mathbf{x}_t$ for $i = 0,1,2, \ldots, N$, Eq. (5) can be written as:

$$\mathbf{G}_{i0}\mathbf{W}_i\mathbf{x}_t = \mathbf{a}_{i0} + \mathbf{a}_{i1}t + \mathbf{G}_{i1}\mathbf{W}_i\mathbf{x}_{i,t-1} + \cdots + \mathbf{G}_{ip_i}\mathbf{W}_i\mathbf{x}_{i,t-p_i} + \mathbf{u}_{it}. \quad (6)$$

Stacking these individual models for $i = 0,1,2, \ldots, N$ to generate the model for $\mathbf{x}_t$ **:**

$$\mathbf{G}_0\mathbf{x}_t = \mathbf{a}_0 + \mathbf{a}_1 t + \mathbf{G}_1\mathbf{x}_{i,t-1} + \cdots + \mathbf{G}_p\mathbf{x}_{i,t-p} + \mathbf{u}_t, \quad (7)$$

where $p = \max(p_i)$ and q= max (q_i) and

$$\mathbf{G}_0 = \begin{pmatrix}\mathbf{G}_{00}\mathbf{W_0}\\ \mathbf{G}_{10}\mathbf{W_1}\\ \vdots\\ \mathbf{G}_{N0}\mathbf{W_N}\end{pmatrix}, \quad \mathbf{G}_j = \begin{pmatrix}\mathbf{G}_{0j}\mathbf{W_0}\\ \mathbf{G}_{1j}\mathbf{W_1}\\ \vdots\\ \mathbf{G}_{Nj}\mathbf{W_N}\end{pmatrix} \text{ for } j = 1,2, \ldots, p,$$

$$\mathbf{a}_0 = \begin{pmatrix}\mathbf{a}_{00}\\ \mathbf{a}_{10}\\ \vdots\\ \mathbf{a}_{N0}\end{pmatrix}, \quad \mathbf{a}_1 = \begin{pmatrix}\mathbf{a}_{01}\\ \mathbf{a}_{11}\\ \vdots\\ \mathbf{a}_{N1}\end{pmatrix}, \mathbf{u}_t = \begin{pmatrix}\mathbf{u}_{0t}\\ \mathbf{u}_{1t}\\ \vdots\\ \mathbf{u}_{Nt}\end{pmatrix}.$$

Because $\mathbf{G}_0$ is a known non-singular matrix that depends on the trade weights and parameter estimates, premultipliying Eq. (7) by the inverse of $\mathbf{G}_0$, the GVAR(p) model is obtained in its reduced form as follows:

$$\mathbf{x}_t = \mathbf{b}_0 + \mathbf{b}_1 t + \mathbf{F}_1\mathbf{x}_{i,t-1} + \cdots + \mathbf{F}_p\mathbf{x}_{i,t-p} + \mathbf{\varepsilon}_t, \quad (8)$$

where $\mathbf{b}_i = \mathbf{G}_0^{-1}\mathbf{a}_i, i = 0,1; \mathbf{F}_j = \mathbf{G}_0^{-1}\mathbf{G}_j, j = 1, \ldots, p; \mathbf{\varepsilon}_t = \mathbf{G}_0^{-1}\mathbf{u}_t$.

Based on Eq. (8), we calculate the forecast error variance decomposition of inflation for SSA economies.

The GVAR model includes five country-specific variables for each country-VARX* model $\mathbf{x}_{it} = (dCPI_{it}, dRGDP_{it}, dNEER_{it}, dM_{it}, NIR_{it})$. With the exception of the U.S. model, all models include country specific (weakly exogenous) foreign variables $\mathbf{x}^*_{it} = (dCPI^*_{it}, dGDP^*_{it}, dM^*_{it}, NIR^*_{it})$ as in Pesaran et al. (2004).[11] Global oil and food prices are also modeled as weakly exogenous for all countries but the U.S. as in line with Dees et al. (2007. We test the weak exogeneity assumption for these variables based on the methodology outlined in Johansen (1992) and Harbo, Johansen, Nielsen, Rahbek (1998). The results reveal that in only 25 out of 264 cases, exogeneity assumption is rejected. Moreover, most of the cases are for non-SSA countries, and this number reduces with higher lag length (q_i). Note also that model specification is selected to satisfy the stability condition in which all the eigen values of the GVAR model are not greater than one.

III. Empirical Results and Discussions

In this section, we first estimate the relative importance of different types of shocks for the inflation process in SSA economies, using generalized forecast error variance decomposition analysis (FEVD) for the full-sample 1988:1–2013:1.[12] We then test for a structural break in the data and study whether the inflation dynamics in the region has changed over time.

In the analysis that follows, supply shocks represent shocks to oil prices, food prices, and inflation itself; whereas demand shocks refer to shocks to real activity, the nominal effective exchange rate, money supply and nominal interest rates.[13] Domestic factors refer to the impact on domestic inflation of domestic supply and demand shocks, regional factors to the impact of shocks in other SSA economies, and global factors to the impact of shocks in the 32 non-SSA economies of the model including the global oil and food shocks.

A. What are the Drivers of Inflation in Sub-Saharan Africa?

The results from the empirical analysis suggest that both supply and demand shocks have been important drivers of inflation in NCFA-SSA. In particular:

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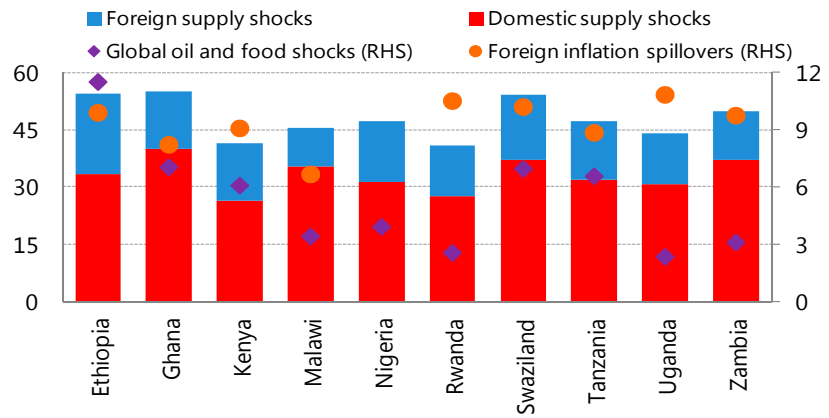
[11] Given the importance of the U.S. financial variables in driving the global financial variables, U.S. specific foreign variables would be unlikely to be weakly exogenous with respect to the U.S. domestic variables. The U.S. specific foreign output and inflation variables, $dGDP^*_{it}$ and $dCPI^*_{it}$, are however included in the U.S. model in order to capture possible spillover of external shocks to the U.S. economy.

[12] See Koop, Pesaran and Potter (1996) and Pesaran and Shin (1998) for a detail description of generalized FEVD. The advantage of generalized FEVD relative to orthogonalized FEVD is that the former does not require identification restrictions (or the ordering of the endogenous variables).

[13] We bundle exchange rates and domestic monetary variables together for the ease of interpretation. Changes in the exchange rate could be related to changes in foreign money variables or terms of trade. However, such fluctuations are controlled for in the GVAR by including these variables in each country's model in the form of trade-weighted foreign money variables and trade-weighted foreign consumer price inflation.

- Supply shocks explain about 45 percent of the inflation fluctuations in the region on average, one-third of which reflect shocks to global commodity prices and inflation spillovers from other countries, and the other two-thirds reflect other supply shocks to inflation such as weather-related shortfalls (Figure 1).

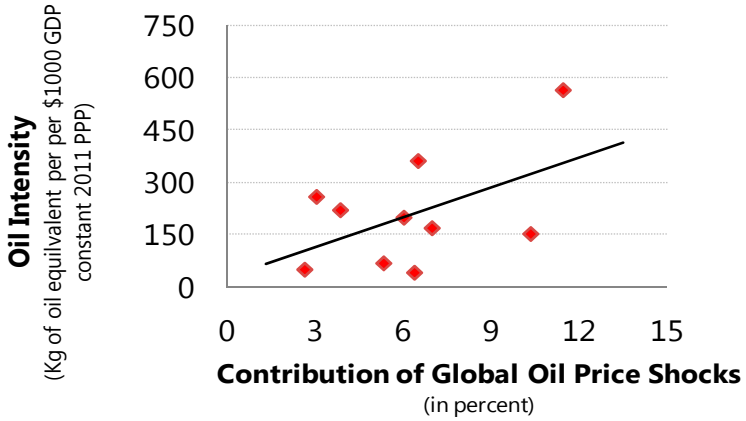
Figure 1. Selected NCFA-SSA: Contribution of Supply Shocks to Inflation Variations[1]



[1]Generalized forecast error variance decomposition over 10 quarters.
Source: IFS Database of the IMF. and authors' calculations.

Shocks to global oil and food prices explain about 7 percent of inflation fluctuations in the region. In general, global commodity prices contribute more to inflation in economies that have higher oil intensity (defined as a kilogram of oil equivalent per capita) (Figure 2). The contribution of global oil and food price shocks to inflation is particularly significant among the largest oil and/or food importers (relative to GDP) in NCFA-SSA (Botswana, Mauritius, Seychelles, and Swaziland).

Figure 2. NCFA-SSA: Contribution of Global Oil Shocks to Inflation and Oil Intensity[1]

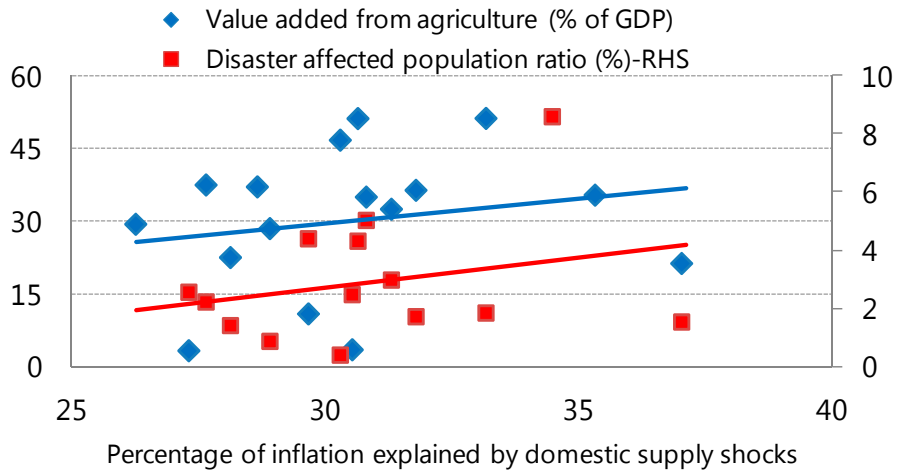


[1]Generalized forecast error variance decomposition over 10 quarters. South Africa is excluded.
Source: IFS Database of the IMF, WDI of the WB, and authors' calculations.

Foreign inflation spillovers are also important in driving inflation with a contribution of 8 percent on average, reflecting imported inflation from other countries. As expected, the importance of foreign inflation spillovers generally increases with higher imports. For example, Mauritius, Seychelles and Cabo Verde have higher imports (as a percent of GDP) than the regional average, and have been more open to inflation spillovers from other economies.

In most of NCFA-SSA, domestic supply shocks play a major role—on average,30 percent of inflation is driven by these supply shocks, especially in countries that are more vulnerable to weather-related shocks and more agriculture-based countries (Figure 3).[14] For example, in Ethiopia and Sierra Leone where agricultural value added represents about half of GDP, domestic supply shocks explain about 40 percent of inflation variations. Similarly, Burundi and Malawi are among the countries with higher value added from agriculture (ranging between 30 to 40 percent of GDP) and a bigger role of domestic supply shocks relative to the regional average. The response of inflation to one standard error domestic supply shock is also higher in these countries (Figure 4).[15]

Figure 3. The Contribution from Domestic Supply Shocks to Inflation: The role of Weather Shocks and Agriculture[1]

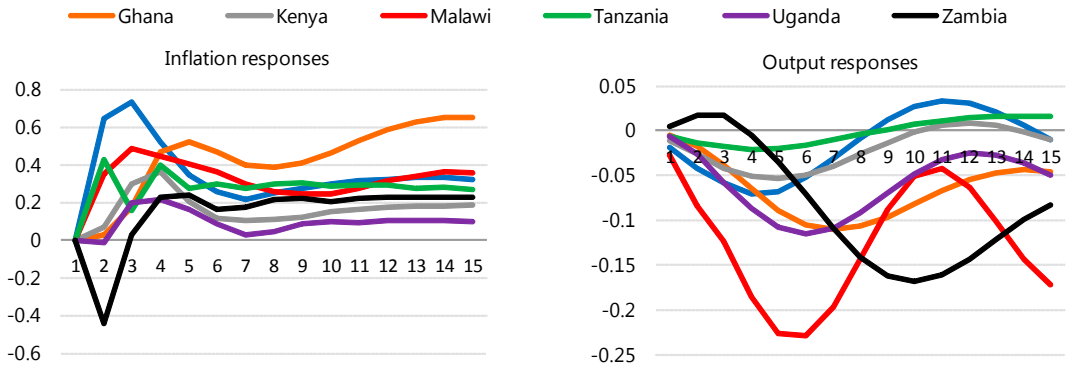


[1]Generalized forecast error variance decomposition over 10 quarters. South Africa is excluded.
Source: IFS Database of the IMF, WDI of the WB, EM-DAT and authors' calculations.

[14] We take the data on disaster affected population (%) from EM-DAT as a proxy for a measure on vulnerability to shocks.

[15] As expected, in most the cases, the response of output to the domestic supply shock is negative. The results are based on generalized impulse responses and are available upon request.

Figure 4. Selected NCFA-SSA: Impulse Responses of Output and Inflation to a Negative Domestic Supply Shock[1]

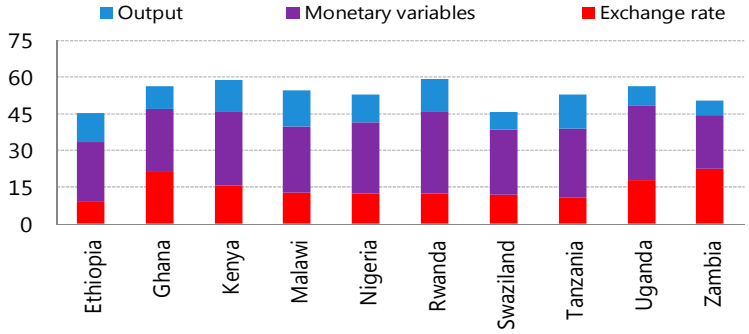


[1]Generalized impulse responses (change, in percent) to a 1 percent shock to a negative domestic supply shock.

Source: IFS Database of the IMF, and authors' calculations.

- Demand shocks explain about 55 percent of fluctuations of inflation in NCFA-SSA, of which nearly three-quarters reflect the impact of shocks to the exchange rate and monetary variables and one-quarter reflects the effect of output shocks (Figure 5). In particular, changes in money supply and interest rates explain about 26 percent of inflation fluctuations. Changes in exchange rates explain about 16 percent, although they play a more important role in those economies (such as Malawi, Seychelles, and Zambia) that experienced relatively large currency swings during the sample period. Changes in the output gap account for about 13 percent of NCFA-SSA's inflation fluctuations.

Figure 5. Selected NCFA-SSA: Contribution of Demand Shocks to Inflation Variations[1]



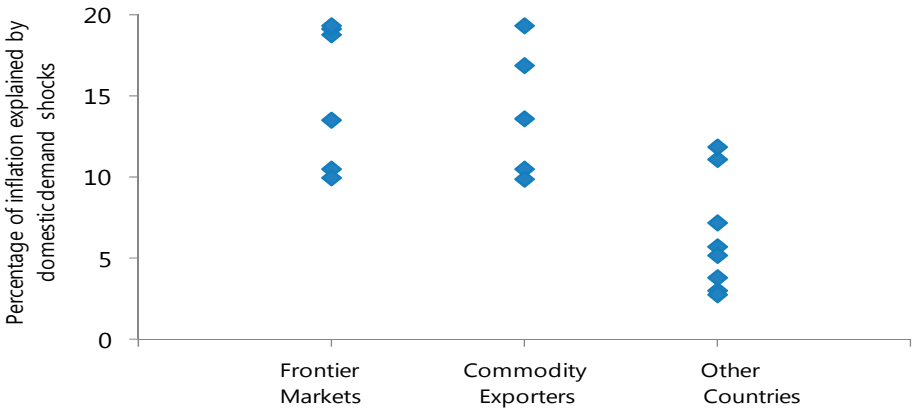
[1]Generalized forecast error variance decomposition over 10 quarters.

Source: IFS Database of the IMF, and authors' calculations.

In terms of geographic origins of the demand shocks, the analysis suggests that about 15 percent of inflation variation is explained by domestic demand factors. The impact of domestic demand factors on inflation is larger for some frontier economies (Ghana, Kenya, Uganda, and Zambia) which usually have a higher demand base (Figure 6). In Burundi and Malawi, two commodity exporters, domestic demand shocks are also more important relative

to other countries. This could arise via the link between volatile commodity prices and government spending, the latter being a major demand component.

Figure 6. Selected NCFA-SSA: Contribution of Domestic Demand Shocks to Inflation[1 2]



[1]Generalized forecast error variance decomposition over 10 quarters. South Africa is excluded.
[2]IMF definition is used for country groupings.

Source: IFS Database of the IMF, and authors' calculations.

Foreign demand shocks explain about 40 percent of inflation fluctuations in NCFA-SSA, among which regional and global factors contributed by 15 percent and 25 percent, respectively. As expected, contribution of demand spillovers from other countries increase with trade openness—in countries where trade openness (defined as the sum of exports and imports over GDP)[16] is the highest (Mauritius, Seychelles and Swaziland—average of 130 percent), foreign demand factors play a much bigger role in driving inflation dynamics (more than 50 percent).

These findings indicate that despite the importance of domestic supply shocks in driving inflation in NCFA-SSA, demand factors have also been important, particularly demand spillovers from the region as well as from the global economy. Nevertheless, given the substantial changes in trade, financial, and policy structure of the region and the world, the dynamics of inflation process might have changed over time. We investigate this in the next section.

B. Have Drivers of Inflation in NCFA-SSA Changed Over Time?

As country-specific models within the GVAR framework are specified conditional on foreign variables, the methodology implicitly accommodates co-breaking (Hendry, 1996; Hendry and Mizon, 1998). For that reason, the GVAR is more robust to the possibility of structural

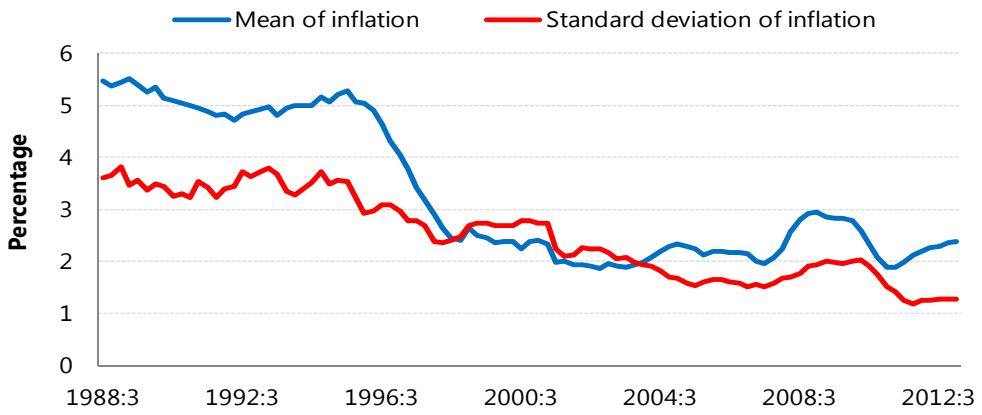
[16] The data source is Penn World Tables, version 7.0.

breaks as compared to standard VAR models or reduced-form single equation models (Cesa-Bianchi et al., 2011; Dees et al., 2008).

Given structural and policy changes in SSA countries (Berg et al. 2015), it would be expected that inflation dynamics have changed over time. Taking into account the challenges in identifying a discrete break point across all countries, we divide the full sample into two sub-samples; 1987:1–1998:4 and 1999:1–2013:1 guided in part by a rolling mean and standard deviation (Figure 7).[17] In order to see the changes in the importance of shocks in driving inflation, we compare the recent sub-sample results with those of the full sample as the first subsample yielded too few observations for a reliable estimation. Appendix I elaborates on the structural break analysis and robustness tests.

The analysis for the more recent subsample reveals that drivers of inflation in NCFA-SSA have been changing over time. In particular:

Figure 7. NCFA-SSA: Mean and Standard Deviation of Inflation (rolling average)[1 2]



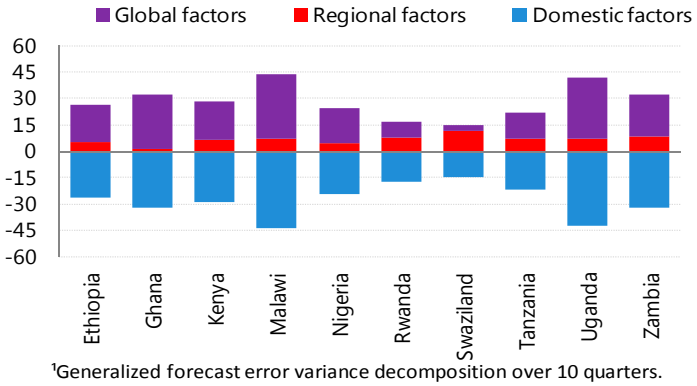
[1]We first calculate rolling average for each country, and then take the mean.
[2] South Africa is excluded.
Source: IFS Database of the IMF and authors' calculations.

- The role of both regional and global factors has risen in most of countries, and by about 20 percent in total on average (Figure 8). This change can be mainly explained by increases in trade and financial openness of NCFA-SSA—both sum of exports and imports as a percent of GDP and capital openness measure (as measured in Jahan and Wang, 2015) increase by more than half during the last two decades, making economies

[17] We also estimate GARCH (1, 1) model to obtain conditional standard errors of inflation for each country, which also point out a fall in the volatility of inflation during the second sub-sample. See also the Appendix on the structural break analysis and robustness tests.

more exposed to foreign factors. At the same time, the importance of global oil and food prices has doubled in the recent period to 13 percent. This could be largely explained by large global commodity price shocks since 2000, particularly during 2007–2008 and 2010–2011.

Figure 8. Selected NCFA-SSA: Changes in the Relative Contribution of Shocks in 1999–2013[1]

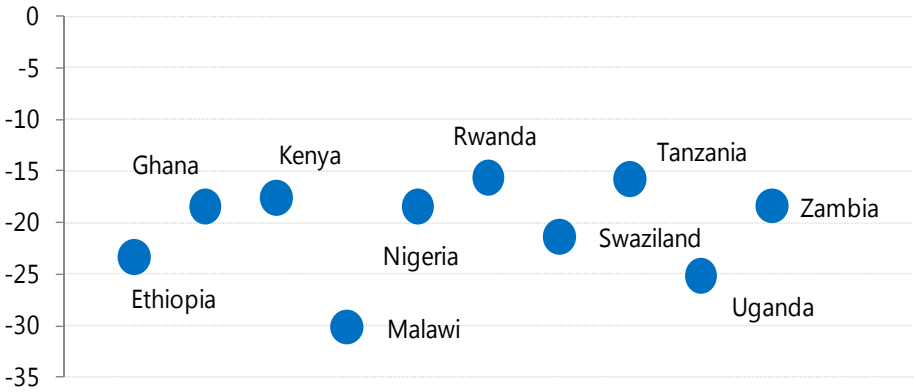


[1]Generalized forecast error variance decomposition over 10 quarters.

Source: IFS Database of the IMF, and authors' calculations.

- The share of domestic supply shocks has reduced in all of NCFA-SSA economies to 13 percent on average from 30 percent for the full sample (Figure 9). More stable environment with the reduction of wars, conflicts and political violence might have contributed to the decline in the role of supply shocks. Some NCAF-SSA economies also became more diverse, improved their infrastructure and strengthened the institutions and policies which could have limited the impact of exogenous supply shocks over time.

Figure 9. Select NCFA-SSA. Changes in the Contribution of Domestic Supply Shocks in 1999–2013[1]



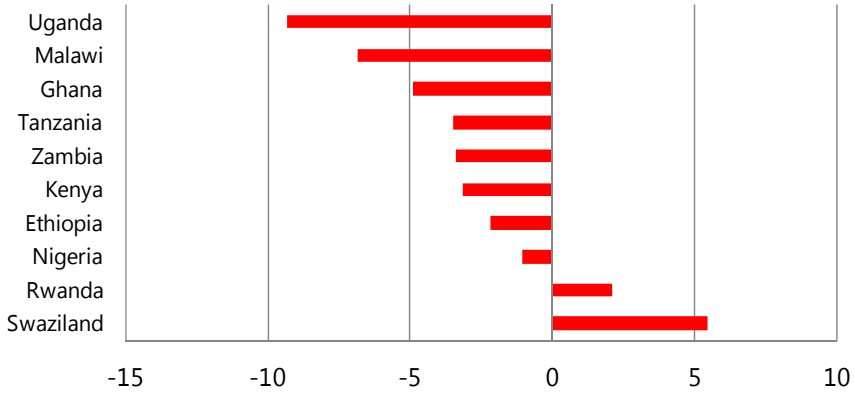
[1]Generalized forecast error variance decomposition over 10 quarters.

Source: IFS Database of the IMF, and authors' calculations.

- With the large decline in the role of domestic supply shocks in the more recent period, domestic demand shocks have became more important among domestic factors, with a

30 percent increase in their role relative to supply side factors. Among the domestic demand factors, however, the contributions of exchange rate and monetary policy shocks have declined by about 4 percent on average in NCFA-SSA, reflecting two factors. First, from the mid-1980s to the late 1990s, many countries in the region began reform programs, often with exchange rate unifications and movement toward more market-determined, flexible exchange rates, and dismantling of exchange and trade controls (Berg et al. 2015). [18] In 2000s, about half of NCFA-SSA countries were classified as having de jure and de facto floating exchange rate regime (IMF, AREAER Database). Second, this change in the exchange rate regimes was accompanied by a move towards more flexible and forward looking monetary policy frameworks—in the last decade or so, monetary policy in many NCFA-SSA countries has gained traction due to increased central bank independence, reduced fiscal dominance, and greater reliance on market-based policies. These reforms helped reduce the role of exogenous, money, and interest rate shocks to inflation in the region (Figure 10).

Figure 10. Selected NFA-SSA. Changes in the Contribution of Domestic Shocks to Monetary Variables in 1999–2013[1]



[1]Generalized forecast error variance decomposition over 10 quarters.

- The contribution of output shocks to inflation variation has increased over the last 15 years in NCFA-SSA. On average, the contribution of output shocks to inflation increased by about 5 percent in the recent period, from 10 percent in the whole period. In frontier economies in our sample, however, the increase is much more pronounced with an average of 10 percent. This in part reflects high growth performance in these countries in the more recent period, together with the increasing demand base.

These findings have some important implications for monetary policy making. There has been a long-standing perception among policymakers in SSA that supply side factors,

[18] In some cases, conditionalities in IMF/WB accompanying new adjustment loan programs brought these reforms.

particularly global commodity prices and domestic weather-related/political shocks, are the main drivers of inflation in the region. Although the prevalence of supply shocks does not invalidate the stabilization role of monetary policy in the medium term, it does imply a limited role for monetary policy in the short run. The growing role for demand-driven pressures in driving inflation, however, calls for a rather active role for monetary policy as an aggregate demand management tool in SSA. A coherent and forward-looking monetary policy framework with clear objectives and instruments would dampen the fluctuations in aggregate demand over the course of the business cycle, in part by anchoring inflation expectations.

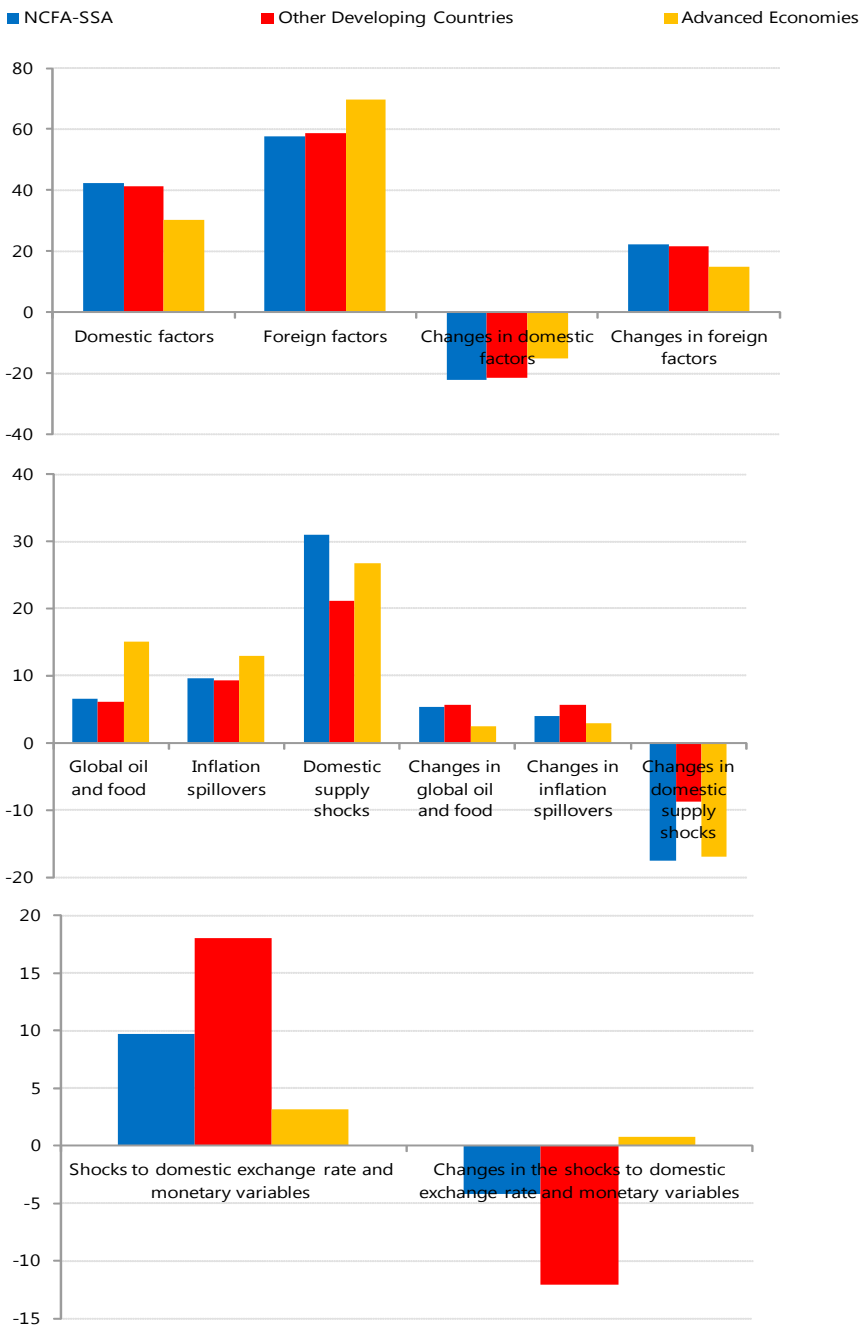
It is noteworthy that more effective demand management through systemic monetary policy responses does not conflict with efforts to promote higher economic growth in SSA. On the contrary, by maintaining price stability and anchoring long-term expectations to a low and stable inflation, such policy practices could reduce economic uncertainty and thereby contribute in one of the most effective way to support long-term growth. Strengthening the monetary policy framework would also help in managing inflation by limiting non-systemic policy action and hence shocks associated with monetary policy responses. Indeed, as discussed above, we find a sharp decline in the role of monetary policy shocks in driving inflation over the last decade in NCFA-SSA economies where greater clarity and transparency with respect to monetary objectives and the use of market-based policy instruments, in some cases within an inflation targeting framework, has been adopted.

C. How Do the Drivers of Inflation in NCFA-SSA Compare With Other Countries?

The GVAR methodology used in this paper allows us to compare the inflation dynamics in different countries and their changes over time in this section. Although the results for all the countries are broadly consistent, there are some important differences (Figure 11).

- Domestic factors play a somewhat more important role in driving inflation dynamics in NCFA-SSA and other developing economies than their advanced counterparts. During the time period we analyze, however, many developing countries, including NCFA-SSA, integrated more to the global economy, increasing the impact of foreign factors on inflation dynamics. Our results show that the contribution of foreign factors in developing countries increased by about 20 percent on average (at par with NCFA-SSA average), and almost reached the level in advanced economies.
- Contributions of global oil and food shocks and inflation spillovers to inflation are about 8 percent higher on average among advanced economies, potentially reflecting the impact commodity and goods imports from other economies. In the more recent period, both in NCFA-SSA and in other developing countries, we observe an increase in the role of both factors in inflation dynamics.

Figure 11. Inflation Drivers in NCFA-SSA vs. Other Developing Countries and Advanced Economies[1 2]



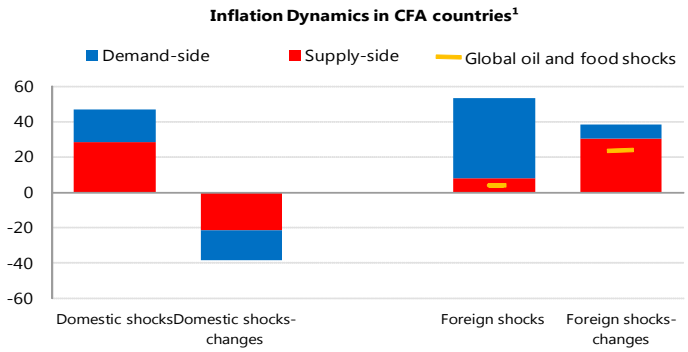
[1]Generalized forecast error variance decomposition over 10 quarters. South Africa is excluded.
[2]IMF definition is used for country groupings.

Source: IFS Database of the IMF, and authors' calculations.

- The role of domestic supply shocks is much higher in NCFA-SSA than other developing countries. As explained earlier, the region faces large and frequent supply shocks, which generally feed into inflation rapidly. In line with the results in NCFA-SSA, the results point to a decline in the variation of inflation explained by domestic supply shocks across the board.
- As in the case of NCFA-SSA, other developing countries also experienced a decline in the role of domestic shocks to exchange rate and monetary variables over the recent years. This result is not surprising given that many (if not most) developing countries moved toward more flexible exchange rate regime within stronger monetary policy frameworks. In advanced economies, the contribution from these shocks is much smaller for the entire period.

Box 1. Inflation Dynamics in CFA Sub-Saharan African Economies

This box presents key properties of inflation dynamics in the CFA franc zone which includes 14 Sub-Saharan African countries (see Table 2).



[1]Generalized forecast error variance decomposition over 10 quarters.

Source: IFS Database of the IMF, and authors' calculations.

- Domestic factors account for 45 percent of inflation variations in CFA-SSA, while regional and global factors account for 23 and 32 percent respectively. This is broadly in line with the geographic origins of the shocks in NCFA-SSA economies.
- Like in NCFA-SSA, demand shocks play a bigger role (65 percent) than supply shocks (35 percent) in explaining the fluctuations of inflation. However, there are some differences in the structure of demand shocks in comparison to the NCFA countries—the contribution of shocks to exchange rate appear to play bigger role in the CFA countries with about 40 percent of the demand-side shocks, compared to about 30 percent in NCFA countries.
- Domestic supply shocks account for 60 percent of domestic factors, which is 10 percent smaller than that in the NCFA countries.

There have been also important changes in inflation dynamics in the CFA-SSA countries.

- The role of foreign factors has almost doubled, mainly from non-regional factors. The increase in the contribution of foreign supply factors (about 30 percent) is larger than that in the demand factors (8 percent), particularly from global oil and food prices (23 percent).
- Meanwhile, the contribution of domestic factors to inflation variations has fallen from both demand and supply sides by about 15 and 20 percent respectively.
- As opposed to the NCFA economies, the role of demand shocks has become relatively less important than that of supply shocks in the more recent period.

IV. Concluding Remarks

This paper aims to look at the drivers of inflation in SSA and how they have changed over time. The paper also presents a comparison of the drivers in the region with other developing countries and advanced economies.

We find that inflation dynamics across SSA are mainly driven by domestic supply shocks, although the contribution of these shocks to inflation substantially declined in recent years. As the region becomes more integrated with the global economy, however, the role of global oil and food shocks as well as inflation spillovers from other countries have increased. The importance of regional and global demand shocks have increased as well. This implies that policymakers in the region should be more cautious to the global inflation and growth developments.

We also find that the contribution of demand factors has risen in recent years, especially from shocks to output. These changes in the contribution from different shocks are broadly consistent with the changes in other developing countries. Looking ahead, if the impact of demand factors on inflation continues to grow, policymakers may need to devote greater attention to managing inflation, in addition to promoting growth. The contribution of shocks to exchange rate and monetary variables to inflation has diminished over time in NCFA-SSA, in part reflecting the improvements in monetary policy frameworks in many countries in the region. These improvements have included greater use of market based instruments, along with more clarity and transparency with respect to monetary objectives and instruments as well as exchange rate flexibility. Further progress in this direction may help to further reduce the level and volatility of inflation across SSA.

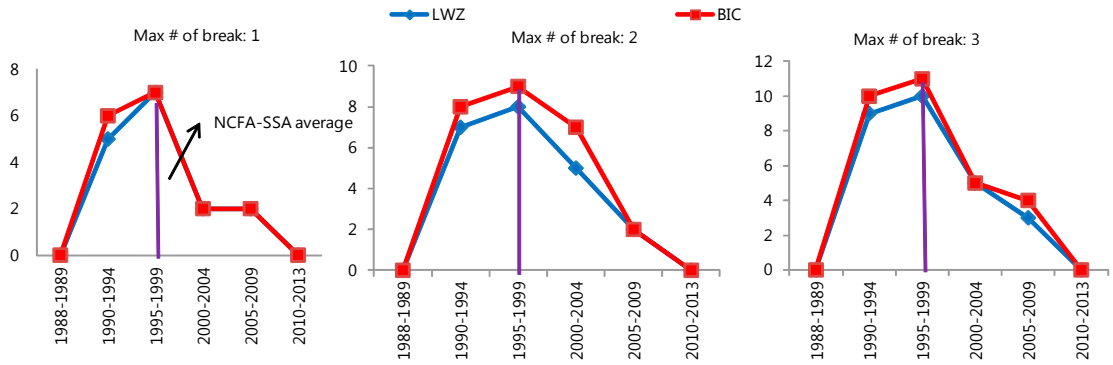
Appendix—Structural Break Analysis and Robustness Tests

As mentioned earlier, we split the sample from 1999:1 to see if the inflation dynamics have changed over time in SSA. In this Appendix, we (i) provide additional analysis to support the break point of our choice, and (ii) present robustness analysis taking 1997:1 as a break point.

A.1. Break Point Analysis and Structural Break Tests

We first apply the Bai and Perron (1998) method to detect changes in inflation dynamics in NCFA- SSA. We consider three cases with maximum breaks 1, 2 and 3 respectively. In each case, the number of breaks is selected by the criterion by Schwarz (1978) (refereed as BIC) and Liu, Wu, and Zidek (1997) (referred as LWZ). As shown in the Figure A.1, the results between BIC and LWZ are similar for different maximum break cases—they all point out a change in inflation dynamics in NCFA-SSA, particularly in the second half of the 1990s. For the average of inflation in the region, the data points to a single break point in the second half of 1990s, plotted by the purple line, regardless the set maximum number of breaks or the selection method.

Appendix Figure A.1. NCFA-SSA. Structural Break Point Estimates[1]



[1] LWZ refers to the criterion Liu, Wu, and Zidek (1997) and BIC refers to the criterion by Schwarz (1978).

Source: IFS Database of the IMF, and authors' calculations.

We then follow Dees et al. (2007) to conduct several structural tests, including Ploberger and Kramer's (1992) maximal OLS cumulative sum (CUSUM) statistic (PK_{sup}) and its mean square variant (PK_{msq}). We also consider tests for parameter constancy against non-stationary alternatives proposed by Nyblom (1989) (NY). In addition, there are sequential Wald-type tests of a one-time structural change at an unknown change point including the Wald form of Quandt's (1960) likelihood ratio statistic (QLR), the mean Wald statistic (MW) of Hansen (1992) and Andrews and Ploberger (1994), and Andrews and Ploberger (1994)'s Wald statistic based on the exponential average (APW). We also present the heteroscedasticity-robust version of the Wald type tests.

Table A.1 summarizes the results of the tests by variable at the 5 percent significant level. The critical values of the tests, computed under the null of parameter stability, are computed using the sieve bootstrap samples obtained from the solution of the GVAR model. For each test, we consider 220 cases and present the number of rejections of the null hypothesis in the column 'Number'. Meanwhile, the rate of rejection is shown in the column 'Rate (%)'. The results confirm the possibility of structural breaks per variable, including inflation, across the country-specific model.

Appendix Table A.1: Number of Rejections of the Null of Parameter Constancy per Variable Across the Country-Specific Models at 5 Percent Significance Level

						Total	
Test	dY	dCPI	dM	R	dNEER	Number	Rate (%)
PK_{sup}	13	6	10	6	7	42	19
$PK\text{-}_{msq}$	13	1	7	2	2	25	11
NY	3	8	4	8	5	28	13
Robust-NY	2	3	4	3	2	14	6
QLR	12	25	14	21	20	92	42
Robust-QLR	3	1	1	2	3	10	5
MW	14	15	10	17	15	71	32
Robust-MW	6	2	3	5	8	24	11
APW	12	25	14	22	21	94	43
Robust-APW	3	1	1	4	3	12	5

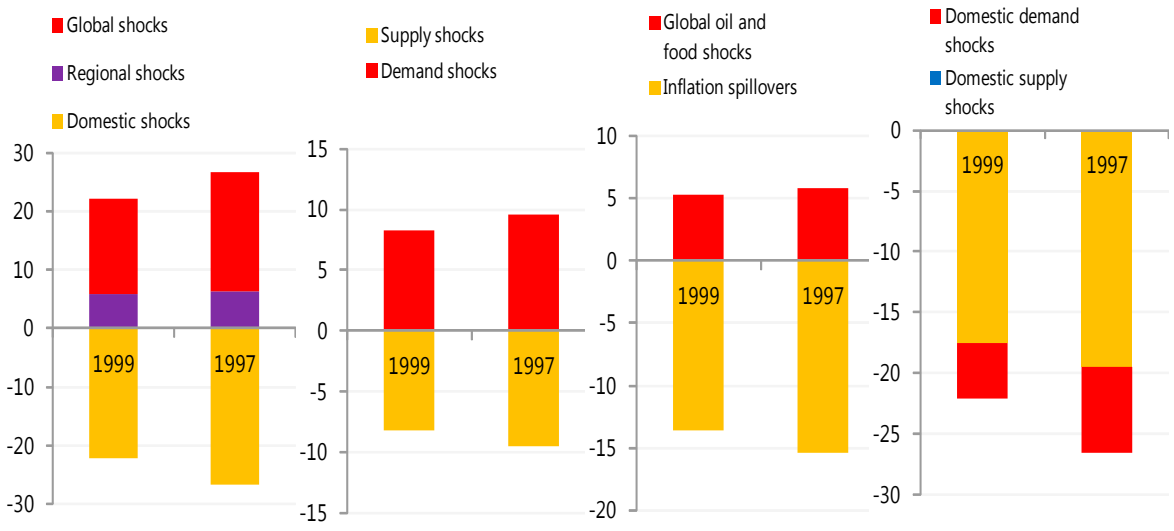
Source: IFS Database of the IMF, and authors' calculations.

A2. Robustness Tests on the Break Points

Structural break analysis presented above indicates a break point for NCFA-SSA at the end of 1990s, but it is difficult identify the exact timing of the break. To see the robustness of our results, therefore, we also estimate the model for the recent sample starting from 1997.

The analysis points out that our results on the changes of inflation dynamics are robust to the break point selection. As shown in Figure A2, the differences in the results for the sample starting from 1997:1 and 1999:1 are very similar, with only a couple of percentage points differences, across geographic origins and the nature of shocks.

Appendix Figure A.2. Changes in the Contribution of Shocks to Inflation in NCFA-SSA: Break Point 1997:1 vs. 199:1



[1]Generalized forecast error variance decomposition over 10 quarters. South Africa is excluded.

Source: IFS Database of the IMF, and authors' calculations.

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