IMF Working Paper

Global Financial Transmission into Sub-Saharan Africa –
A Global Vector Autoregression Analysis

Jorge Canales-Kriljenko, Mehdi Hosseinkouchack,

and Alexis Meyer-Cirkel

INTERNATIONAL MONETARY FUND

IMF Working Paper

African Department

Global Financial Transmission into Sub-Saharan Africa — A Global Vector Autoregression

Prepared by Jorge Canales-Kriljenko, Mehdi Hosseinkouchack, and Alexis Meyer-Cirkel

Authorized for distribution by Céline Allard

December 2014

Abstract

Sub-Saharan African countries are exposed to spillovers from global financial variables, but the impact on economic activity is more significant in more financially developed economies. Generalized impulse responses from a GVAR exercise demonstrate how the CBOE volatility index (VIX) and credit conditions around the globe impact a subset of sub-Saharan African economies and regions. The estimated relationships suggest that the effect of global uncertainty is more pervasive in exports, with the impact on economic and lending activities being mixed. The channels of transmission include the effects of global financial variables on commodity prices and on trading-partner's macroeconomic and financial variables. The analysis suggests that shocks to credit conditions in the euro area and the U.S. have not significantly affected local lending conditions or economic activity in sub-Saharan Africa during 1991-2011, except perhaps in South Africa.

Authors' Email Addresses: jcanaleskriljenko@imf.org, ameyercirkel@imf.org, hosseinkouchack@wiwi.uni-frankfurt.de

Contents

Figures

Tables

I. INTRODUCTION

How do global financial developments affect countries in sub-Saharan Africa (SSA)? Although the region is not significantly integrated into global financial markets, international capital market developments can in principle affect the region through many indirect channels. Sub-Saharan Africa does benefit significantly from foreign direct investment, for example, and adverse global financial conditions can affect the ability of foreign investors to carry out desired projects in the region by impacting the availability and cost of funding at headquarters. Another key indirect channel is the effect that global financial conditions have on domestic demand of SSA's trading partners as well as commodity prices. Both would have an impact on the region through the export channel.

In this paper, we use the global vector autoregression framework developed by Pesaran, Scheuermann, and Weiner (2004) (PSW hereafter) to empiricially explore the channels of transmission from global financial variables into sub-Saharan Africa's economic activity and exports over the last 20 years. We find that sub-Saharan African countries have not been immune to global financial spillovers, but these vary across countries and variables. Global uncertainty has a significant impact on SSA countries through the export channel, while there is no significant relationship between credit supply in key advanced economies and sub-Saharan Africa's output developments. Shocks to global investor sentiment, as measured by the Chicago Board of Options Exchange Volatility Index (VIX), affect exports of the region, especially in those countries that rely heavily on commodities. But the impact on economic activity is significant only in the more financially developed economies. In contrast, shocks to credit conditions in the U.S. or the euro area do not seem to have a significant effect on sub-Saharan Africa, except in South Africa. This suggests that spillovers from the VIX onto economic activity in sub-Saharan African countries may rather come from the effect they have on trading partners than any direct effect on economic activity in the region.

These results are consistent with developments that took place in the region around the global financial crisis. The global financial boom and bust crisis of the second half of the 2000s has provided an example of how financial conditions can spread onto real activity around the world, including sub-Saharan Africa. Data from IMF databases suggest that global trade dropped ten percentage points as a share of global GDP to 43 percent in 2009 from 53 percent in 2008. Direct financial channels included sharp reductions in cross-border lending and sudden stops or plain reversals in other types of capital flows. Indirect channels included the sharp though temporary reductions in oil and other commodity prices, and more importantly the repercussions of the general drop in confidence on households' savings and investment decisions. The impact on sub-Saharan African countries varied with the degree of their financial sector development. While South Africa was impacted to a level comparable to other emerging markets or developed economies, other countries in the region whose financial markets are significantly less developed and globally integrated were affected to a much lower degree.

The paper is organized in five sections. Section II briefly presents the estimation procedure in a global vector autoregression model. Section III describes how the model is specified to identify the

effect of global financial spillovers onto sub-Saharan Africa. Section IV describes the global spillovers from global financial variables using generalized impulse response functions. Section V concludes.

II. LITERATURE, ECONOMIC CONTEXT, AND MODEL

Global vector autoregressions (GVARs) can help study cross-country spillovers from financial and macroeconomic variables by taking into account international linkages. They provide a global consistency framework for a system of country-level time series analysis that exploits cross-sectional relationships (PSW). Cross-country interdependencies are modeled by including foreign variables in the regression for each country.

A. Literature Review

The GVAR model has contributed some stylized facts to the empirical spillover literature. For example, PSW found that shocks that lowered equity prices in the U.S. pulled down global equity prices and, in most regions, also economic activity, although the effect on activity was small. They also found that shocks leading to higher German output tended to increase equity prices in Germany and most of Europe, with the exception of the UK, which seemed to be more integrated to the United States. Dées, di Mauro, Pesaran, and Smith (2007) found that equity and bond market in the U.S. and the euro area follow each other quite closely, while monetary policy shocks in the U.S. have insignificant effects on the output and inflation in the euro area. Castren, Dées and Zaheri (2010) found that firm-level expected default frequencies react most to shocks to GDP, exchange rate, oil prices, and equity prices and argue that the GVAR model can be a useful tool for linking global macro-financial scenarios in stress testing the financial system. Bussière, Chudik and Sestieri (2009) have used the GVAR to model global trade flows. Cashin, Mohaddes, and Raissi (2012) have explored the relationship between systemic economies and MENA cycles. Cashin, Mohaddes, Raissi, and Raissi (2012) have also used the framework to study the systemic effect of oil shocks.

The GVAR empirical approach to documenting spillovers has been extended to include sub-Saharan African countries. Drummond and Ramirez (2009) were among the first researchers that studied spillovers into the region within a panel regression framework. Samake and Yang (2011) used the GVAR to find evidence of direct and indirect spillovers from the BRIC to low-income countries. Gurara and Ncube (2013) found global real spillovers from Europe and the BRIC group onto a comprehensive array of African countries, whereby they particularly focused on growth decline events across different regions and how that impacts African countries' output and exchange rates. Canales-Kriljenko, Mecagni, and Meyer-Cirkel (2012) used the framework to explore financial spillovers onto sub-Saharan Africa as part of a broader exercise in the Regional Economic Outlook for sub-Saharan Africa, which is now expanded and presented comprehensively here. In particular, they focused on the financial spillovers arising from events that affect global investor uncertainty and credit conditions in advanced economies onto economic developments in four country groups in sub-Saharan Africa.

B. Developments Affecting Sub-Saharan Africa

From the point of view of the global economy, sub-Saharan African countries are among the small open economies discussed in the literature. Individuals and firms in these economies take prices as

given for most macroeconomically relevant variables. Although some sub-Saharan African countries like South Africa may have market power in a few items like platinum, they take prices as given for most of the goods that households and firms in sub-Saharan African countries consume and employ in their investment activities.

For about half of sub-Saharan African countries that are net commodity exporters, commodity prices are a crucial element of the external environment that they face. And for these economies, the external environment has been very favorable over the last ten-to-fifteen years analyzed in this paper. Commodity prices have doubled or tripled over this period bringing windfall gains that have increased purchasing power abroad and allowed more individuals to move into cities, as purchasing food abroad has become increasingly feasible.

On the financial side, the global economy has experienced a roller coaster that has had an impact in the more financially developed economies in sub-Saharan Africa. The degree of uncertainty in global financial markets, as measured by the Chicago Board of Options Exchange Volatility Index (VIX) fell sharply from 2003 through 2007. Then it rose rapidly with the global financial crisis, before falling to the contained subsequent levels, which were driven by both easy global financial conditions and more anchored expectations. This contrasts with the low global interest rate environment that has prevailed in the international arena since the onset of the global financial crisis. Low interest rates, when combined with low global uncertainty, tends to expand significantly the access that less financially developed economies have to international financial markets.

Commodity Prices
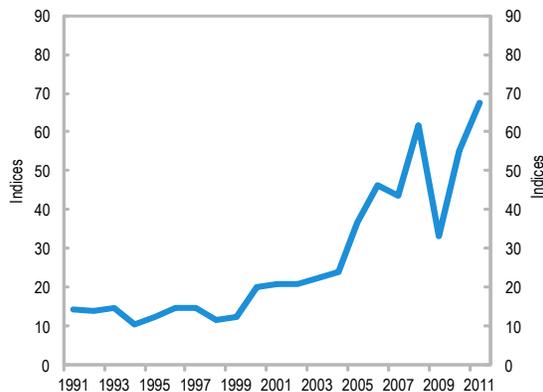
Chicago Board of Options Exchange Volatility Index (VIX)
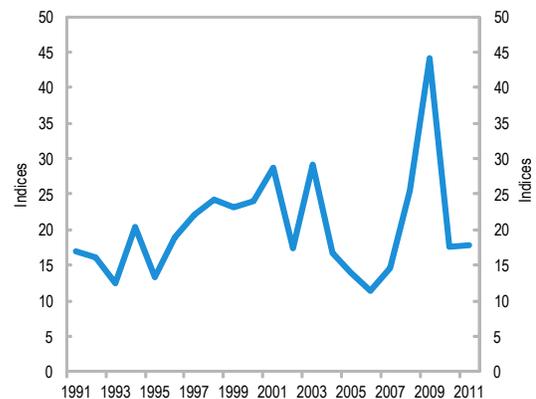
Source: Bloomberg, Inc.

Nevertheless, differences in the speed of financial integration appear across income groups in sub-Saharan Africa. Cross border loans reported to the BIS can serve as a useful gauge.[1] Across most regions a rapid increase in cross border lending started around 2005/06. When normalizing those flows by the respective national GDP, things are put in better perspective. For SSA Developing, the ratio has been broadly fluctuating around a stable trend. While the commodity exporting countries have historically been able to borrow abroad more extensively in recent years, their relative

---

[1] We use Table 7A on outstanding BIS reported loans by all reporting banks vis-a-vis all sectors, and the respective countries or regions described (available at http://www.bis.org/statistics/bankstats.htm).

exposure has dropped. This is explained by various factors, including fast economic growth (bloating the denominator) as well as improved access to alternative financing instruments, such as foreign currency denominated debt issuance. For the more financially developed regions, South Africa and SSA East Advanced (AFREAST: Kenya, Mauritius, Uganda), the picture is quite different. South Africa has had a relatively constant cross border lending stock[2] in US dollars until about 2005, after which that level basically doubled. As a ratio to GDP the picture is more volatile and driven by growth, as well as exchange rate fluctuations. The starkest dynamics can be seen for SSA East Advanced, where both the nominal as well as the ratio to GDP of cross border lending has expanded rapidly, particularly since 2005.

Total Cross-border Loans
(In USD millions)

- South Africa
- SSA Developing
- SSA Commodity Exporters
- SSA East Advanced

Average Cross-border Loans
(In percent of GDP)

- South Africa
- SSA Developing
- SSA Commodity Exporters
- SSA East Advanced (RHS)
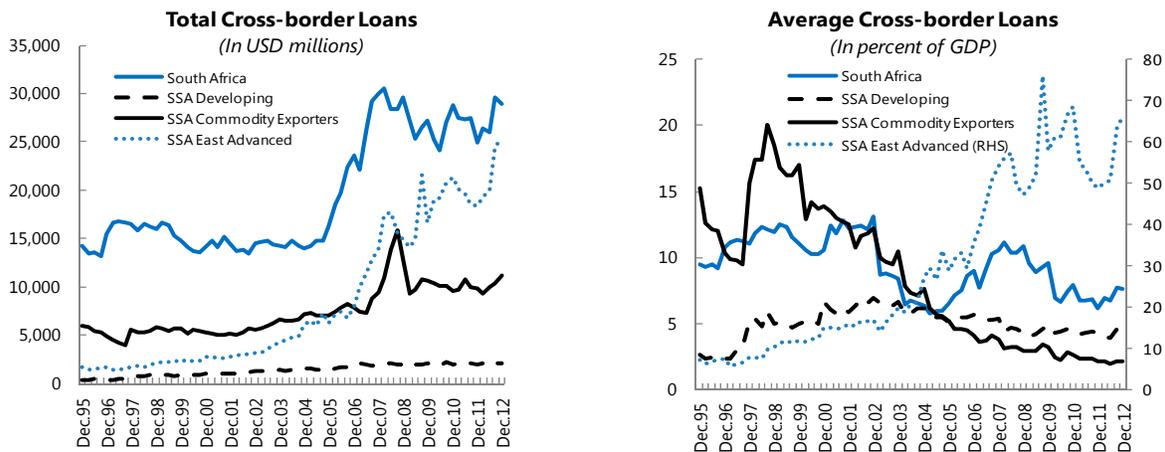
Source: BIS.

The commodity price dynamics explain most of the rapid increase in export nominal of commodity rich countries, which grew much faster than other sub-Saharan African country groups. The visible decline around the global financial crisis is compatible with the behavior of commodity prices, even if many economies in the region like Angola were sharply increasing their volume of exports around this period, as the resolution of internal conflicts allowed renewed focus on mining activities. Not surprisingly, commodity exporting countries have been among the fastest growing economies in the region, followed by East African economies, many of which have benefited from debt relief, good export conditions, and the resolution of internal conflicts that were taking a toll on their total factor productivity growth (which was negative in many of these countries). Other post-conflict sub-Saharan African developing countries, which were on a similar situation, have started to catch up by increasing their productivity from very low levels.

---

[2] Defined here as outstanding loans reported to BIS reporting banks.

Export Levels
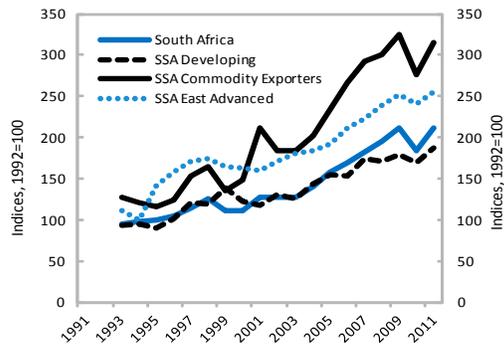
Sub-Saharan Africa Growth Rates
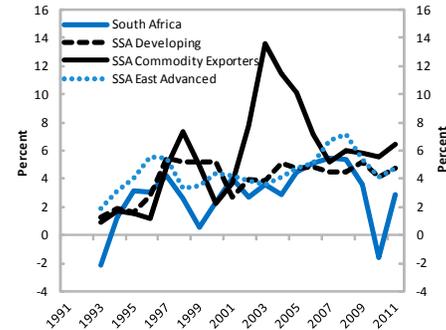
Source: IMF's World Economic Outlook.

The evolution of nominal interest rates has not been uniform across sub-Saharan Africa, although it can safely be said that their levels have been falling over time with consistently lower inflation rates. Country differences partly reflect a variety of monetary and exchange rate frameworks across the region, ranging from tight pegs to the euro to inflation targeting regimes with limited official foreign exchange intervention. Yet, as these frameworks have been relatively stable through the years, variations over time can in principle be affected to a certain degree by external developments. Not surprisingly, then, nominal interest rates around the global financial crisis did show some notable differences across country groups, rising in South Africa and East Africa, while being clearly more subdued in commodity exporters and developing economies, which are less financially developed[3]. Bank lending also shows some different behavior across country groups. Lending rose sharply in the countries experiencing the commodity price and export boom, remaining clearly more subdued in South Africa, which is the most developed financial market in the region and among the most sophisticated in the world. However, lending in South Africa has remained fairly stable, in sharp contrast with the expansion of earlier years.

Nominal Interest Rates
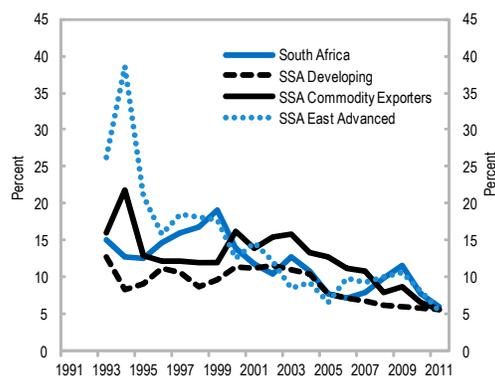
Lending Stock
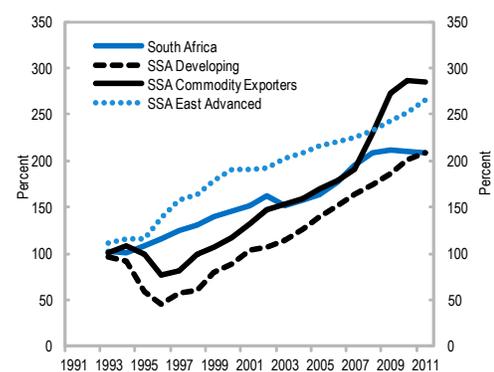
Source: IMF's World Economic Outlook.

---

[3] Country composition of sub-Saharan Africa groups used in the econometric exercise is presented in Table 1 later in the text.

For financial development, we are guided in this paper by the World Economic Forum Competitiveness indicators, in which South Africa is ranked among the top ten in the world. In turn, the East African countries in our sample are clearly better ranked, on average, than commodity exporting or developing sub-Saharan African economies. The level of financial development of the last two country groups is below that of the world median and in our sample their level of development is equally low.

To disentangle how much of the developments we have observed in sub-Saharan Africa reflects spillovers from bigger economies, we turn for help to a version of the global vector autoregressive model developed by PSW.

Financial Sector Development Rankings [1]
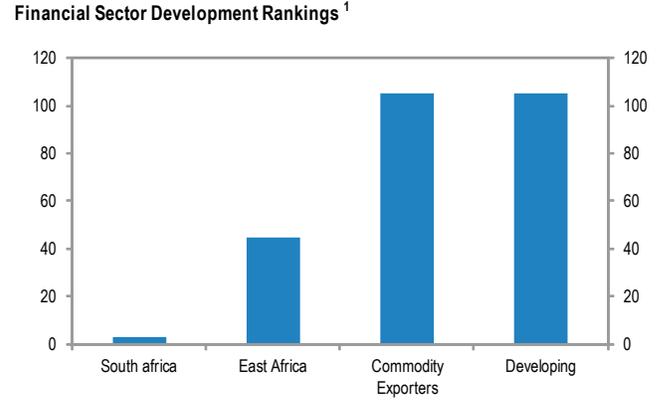
1 A lower number indicates a better ranking.
Source:World Economic Forum

C. The Model

The GVAR basic modeling strategy is to estimate a system of mutually consistent and interrelated time series regressions. For each country, it estimates a vector autoregression that includes domestic and foreign variables. The foreign variables are of two kinds. First, they include a set of external variables deemed exogenous to all but one country in the panel. Second, they include the weighted average of some domestic variables of the trading partners for each country in question.

In more precise notation, consider N countries/regions indexed $i = 1,2, \dots, N$. Let x_{it} be $k_i \times 1$ vector of domestic variables and x_{it}^* be a $k_i^* \times 1$ vector of foreign variables for country i, with $t = 1,2, \dots, T$ indexing time. Following PSW, for country i we would then consider the following vector autoregression equation

$$x_{it} = a_{i0} + a_{i1}t + \Phi_{i1}x_{i,t-1} + \cdots + \Phi_{ip}x_{i,t-p} + \Lambda_{i0}x_{it}^* + \Lambda_{i1}x_{i,t-1}^* + \cdots + \Lambda_{iq}x_{i,t-q}^* + \varepsilon_{it},$$

which is a $VARX^*(p,q)$ model. x_{it} is the set of endogenous variables. The foreign variables are constructed as a weighted sum of the endogenous variables, that is, $x_{it}^* = \sum_{j=1}^{N} w_{ij}x_{jt}$, where the weights, w_{ij}, are calculated reflecting the size of exports from one country/region to every other country/region in the sample. As in PSW, we assume that the idiosyncratic error terms of each country regression are serially uncorrelated and weakly correlated across countries, i.e., $\varepsilon_{it} \sim iid(0, \Sigma_i)$.

For consistency and to exploit the cross-equation interrelationships, the country-specific vector autoregression equations are stacked and transformed into a vector error correction representation. All the vector autoregression equations in the system can be expressed in a compact form. For simplicity let $p \geq q$. Let $x_t = (x_{1t}, x_{2t}, \dots, x_{Nt})'$, then we could collect all the foreign and domestic variables as $z_{it} = (x'_{i,t}, x_{i,t}^{*'})'$. Hence for each country we could write:

$$A_i z_{i,t} = a_{i0} + a_{i1}t + A_{i1}z_{i,t-1} + \cdots + A_{ip}z_{i,t-p} + \varepsilon_{it},$$

Where $A_i = (I_{k_i}, -\Lambda_{i0})$ and $A_{ij} = (\Phi_{ij}, \Lambda_{ij})$. With an appropriate choice of W_i, we may write $z_{it} = W_i x_t$ which in turn helps stacking the whole model as:

$$Gx_t = a_0 + a_1 t + H_1 x_{t-1} + H_2 x_{t-2} + \cdots + H_p x_{t-p} + \varepsilon_t,$$

with G and H_j, $j = 1,2, \ldots, p$ defined as

$$G = \begin{pmatrix} A_1 W_1 \\ A_2 W_2 \\ \vdots \\ A_N W_N \end{pmatrix}, H_j = \begin{pmatrix} A_{1j} W_1 \\ A_{2j} W_2 \\ \vdots \\ A_{Nj} W_N \end{pmatrix}.$$

The external variables considered in our specification that are common to all countries include an oil price index o_t and a volatility index v_t in the model, the Chicago Board of Options Exchange volatility index (VIX). We include them by forming an augmented $VARX^*$ as:

$$Gx_t = a_0 + a_1 t + H_1 x_{t-1} + \cdots + H_p x_{t-p} + \Psi_0 d_t + + \Psi_1 d_{t-1} + \cdots + \Psi_r d_{t-r} + \varepsilon_t.$$

where $d_t = (o_t, v_t)'$.

Upon invertibility of G the model can be solved for x_t. To take the possibly existing co-integration relationships into account, we resort to the error correction representation of the model. This specification is valid for variables that are integrated up to order one.

Three conditions, which are discussed at length in PSW, need to hold for the estimation approach of the model to be valid. First, the model should be stable after normalizing by G^{-1}. This assumption would be satisfied if the eigenvalues of the associated companion matrix fall inside or on the unit circle. Second, the weights used in the construction of foreign-specific variables must be relatively small, so that the squared sum of those weights for each country tends to zero, or more formally, that all elements of the weighting matrix must be at most of order $1/N$ and the sum of square must be sufficiently close to zero as N grows. Third, the idiosyncratic error term should only be weakly correlated across countries.

III. DATA AND SPECIFICATION SETUP

We estimate our empirical model with data for 39 countries from the first quarter of 1991 to the second quarter of 2011. For tractability, some of the 39 countries are bundled in groups, and the paper presents estimates for six countries and seven country groups (Table 1).

Country choice was influenced by data availability and the strength of economic and financial ties to Africa, partly reflecting former colonial history and local presence of, for instance, bank branches, in sub-Saharan Africa's banking systems. Variable choice was also considerably constrained by data availability. On the financial sector side a series of potential transmission channels could be looked at, ranging from cross border lending to different forms of portfolio flows or stock index performance. Given the paper's focus on assessing the potential linkages to sub-Saharan Africa, a much narrower set of variables is available to choose from. Due to its broad country coverage, private-credit-to-GDP ratios and short-term interest rates have been selected as a gauge for the financial sector developments.

Table 1. Countries and Regions Included in the GVAR Exercise

USA	Japan	China	India	South Africa	Other
					Kuwait
UK	**Asia**	**Latin America**	**SSA Developing**	**SSA Commodity Exporters**	Turkey
	Indonesia	Argentina	Benin	Cameroon	
Europe	South Korea	Brazil	Burkina Faso	Chad	**SSA East Adv.**
France	Malaysia	Mexico	The Gambia	Republic of Congo	Kenya
Germany	Philippines	Peru	Mali	Equatorial Guinea	Mauritius
Portugal	Singapore		Niger	Gabon	Uganda
Spain	Thailand		Senegal	Nigeria	
Switzerland			Malawi		

Source: Authors' classification.

Domestic variables include the following: (1) real GDP (y_{it}), (2) short-term nominal interest rates[4] (i_{it}), (3) real domestic private credit (len_{it}), and (4) total exports in U.S. dollars (exp_{it}). Real domestic private credit was obtained by deflating the consumer price index. Except for interest rates, all series are log normalized. Real GDP is seasonally adjusted and, in some countries, obtained from simple linear interpolation of annual data to obtain the quarterly series. For Latin America we have excluded the domestic nominal interest rate from their VARX* specification, given its hyperinflation episode in the first half of the 1990s, which distorted the estimation.

Global variables included in our specification are (1) the Chicago Board of Options Exchange (CBOE) Volatility Index (VIX) (v_t), and (2) the WTI Crude Oil Spot Price (o_t) converted to SDR.

Foreign variables include the trading partner's real GDP, interest rate, real domestic private credit, and exports. External developments affect each country partly by the way in which they affect their partners in external trade. For each country/region, the trading partner's foreign variables are computed as a weighted sum of the respective domestic variable for each trading partner. The

---

[4] Short-term interest rates are measured as a money market rate, policy rate, discount rate or deposit rate depending on data availability.

weights used are constructed from bilateral exports data[5] from the IMF's Direction of Trade Statistics (DOTS) database averaged over 2006-08 (Table 2).

Table 2: Regional and Country-level Trade Shares

Export Destination	Export Origin												
	SSA Developing	SSA East Adv.	SSA Commodity Exporters	Latin America	Europe	Asia	Other	UK	USA	S. Africa	India	China	Japan
SSA Developing	.	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00
SSA East Adv.	0.01	.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.00	0.00
SSA Comm. Exporters	0.09	0.02	.	0.01	0.01	0.01	0.00	0.01	0.02	0.02	0.02	0.01	0.00
Latin America	0.01	0.00	0.07	.	0.07	0.04	0.01	0.02	0.30	0.02	0.04	0.04	0.03
Europe	0.39	0.30	0.20	0.10	.	0.10	0.30	0.51	0.18	0.24	0.14	0.13	0.08
Asia	0.07	0.04	0.03	0.03	0.09	.	0.20	0.06	0.16	0.07	0.21	0.20	0.29
Other	0.01	0.00	0.01	0.00	0.06	0.01	.	0.02	0.02	0.01	0.03	0.02	0.01
UK	0.04	0.38	0.01	0.02	0.28	0.04	0.11	.	0.08	0.13	0.08	0.05	0.03
USA	0.08	0.16	0.49	0.75	0.28	0.26	0.12	0.27	.	0.18	0.26	0.35	0.31
S. Africa	0.05	0.03	0.02	0.01	0.02	0.01	0.01	0.02	0.01	.	0.03	0.01	0.01
India	0.13	0.03	0.07	0.01	0.03	0.05	0.07	0.03	0.02	0.04	.	0.03	0.01
China	0.09	0.01	0.08	0.06	0.10	0.28	0.04	0.03	0.11	0.08	0.12	.	0.22
Japan	0.02	0.02	0.02	0.02	0.06	0.20	0.13	0.03	0.11	0.17	0.04	0.16	.

Source: *IMF, Direction of Trade Statistics (DOTS)*

According to Table 2, during 2006-08, Europe was the most important trading partner region for most of the sub-Saharan Africa country groups. Europe's share as a market destination varied between 20 and 39 percent. In addition, the United Kingdom was the most important export market destination for the frontier sub-Saharan East African markets (Mauritius, Kenya and Uganda) averaging 38 percent. Together, United Kingdom and (the rest of) Europe received almost 70 percent of AFREAST's market's exports. Exports to China amounted to 8 or 9 percent in sub-Saharan Africa, except in AFREAST markets. Exports to India were important to the developing sub-Saharan Africa countries considered here. Intra-African trade was very limited. Since 2008, trade with China and inter-African trade has gained importance (see Drummond and others, 2011).

Other stylized facts from the data include the following: For Europe, the main export market destinations are the U.S. and the United Kingdom. For the U.S., Latin America is the main export market followed by Europe and Asia. Chinese exports mainly went to the U.S., Asia, and Europe. Latin America's main trading partner is by far the United States.

The time series for the country groups included in the specification are constructed using as time-invariant weights the constant-purchasing power (PPP) GDPs of group member countries in percent of the sum of the PPP adjusted GDPs of all member countries for 2010 (see also PSW).

The statistical properties of the series and the weak exogeneity tests that are required for the validity of the estimation approach are presented in Annex A. The estimation strategy requires that model parameters are stable over time and that global and country-specific foreign variables are integrated

---

[5] To calculate bilateral importance, not many potential variables exist. Comprehensiveness of bilateral trade data by DOTS make it the most common used variable for these types of GVAR exercises. For more advanced economies, alternative measures, such as bilateral capital flows, have been used. Note that data are from the portfolio flow surveys incomplete and hence cannot be used in our analysis. For robustness, we have also used a different weighting matrix, computed for the time span 1990-2000 – see table 6 in the appendix for details. This, however, did not make for any substantial changes to our main results presented in the next section.

of order one and weakly exogenous. The conventional statistical tests indicate that most country-specific foreign variables for most regions are integrated of order one and at least one cointegration relationship in all country/groups exists. Finally, most foreign and global variables are weakly exogenous, except for real interest rates for the U.K. and the VIX for the Euro area and AFR commodity exporters (AFRCOM).

IV. RESULTS FROM THE GENERALIZED IMPULSE RESPONSE ANALYSIS

The Global Impulse Response Functions (GIRFs) generated from the GVAR model provide a useful way to characterize the dynamic evolution of variables in the system and thus characterize real and financial spillovers. The GIRFs are invariant to the ordering of variables and do not require identification restrictions. For a shock to a specific variable in an individual country, the global impulse response function incorporates the effects of other shocks using the historically observed correlation of errors (Koop, Pesaran, and Potter, 1996; Pesaran and Shin, 1998; Pesaran and Smith, 1998). However, the interpretation of impulse-response dynamics can be challenging because when shocks are correlated across equations, it is not possible to single out an individual variable and the GIRFs do not imply causality. Nevertheless, the GIRFs can unveil potential linkages and insights about propagation of disturbances across countries.[6]

A. The Investor Uncertainty Channel

The GVAR suggests that an increase in global investor uncertainty, measured by the CBOE Volatility Index (VIX), could affect sub-Saharan African countries through a variety of channels. First, a rise in the VIX tends to reduce commodity prices such as that of oil. In particular, a one standard error positive shock to the VIX lowers oil prices (*comm*) by about SDR 3.3, about US$4.7 at the exchange rate for end-2011 (Figure 1). The median estimates of the impulse response functions suggest that the effect would be persistent, although the wide error bands around the median estimates suggest a considerable margin of statistical error, which could, among other things, imply only a fleeting effect.[7]

Higher investor uncertainty also seems to systematically affect economic activity and exports around the world. In principle, investor uncertainty could impact individual countries' GDP (y) and exports (exp) through both demand and supply channels, including investment hold-ups due to companies' uncertain business expectations, higher lending requirements from raised financial institutions' risk awareness, postponed household investment and consumption behavior, among others. The median impulse responses suggest that the impact on country group output could be considerable. In terms of export reductions, the largest impact would be felt by AFRCOM, where a

---

[6] In contrast, when using traditional impulse-response functions, shocks are orthogonal and depend on the ordering of variables and countries (Sims 1980).

[7] GVAR estimations often have wide error bands around the median estimates. At best, the impact can be thought of being mostly negative because the point estimates are negative and the confidence bands cover responses that are mostly negative.

one standard deviation jump in the VIX, leads to a median drop of 11.8 percent in nominal USD exports after a four quarter period. It is important to add, as can be clearly seen in Figure 1, that increased global uncertainty has a substantial impact on commodity prices. Hence, since generalized impulse-response functions are identified here, it cannot be ruled out that parts of the impact felt in AFRCOM is actually transmitted through changes in international commodity prices. Next, South Africa would experience export shortfalls of 7.5 percent over the same period. AFRDEV and AFREAST's exports are impacted to a much smaller degree, with an estimated drop of two and one percent, respectively.

But increased uncertainty will permeate the economic system through various channels, as discussed, ultimately reducing overall economic activity. The more exposed country groups include ASIA, and EURO where countries will experience a median drop of GDP in the order of, 1.0 percent, 1.1 percent, and 0.8 percent, respectively, in the course of a four quarter period. In sub-Saharan Africa the impact would be strongly felt only in South Africa (-0.8%), moderately in AFREAST countries (-0.2%), while AFRCOM and AFR Developing (AFRDEV) would be basically untouched by global shocks to global volatility spikes. Confidence bounds are mostly in the negative spectrum for all countries, except for AFRCOM and AFRDEV where confidence intervals are quite evenly spread around zero. Interestingly, the effect on investor uncertainty in sub-Saharan Africa is greater on the more financially integrated economies, even when commodity exporters may be directly affected by the impact of falling commodity prices. In short, higher global investor uncertainty would likely affect economies in sub-Saharan Africa, but the effect would vary across country groups. Its effect on commodity prices and global economic activity would translate into lower economic activity in the more financially integrated regions in sub-Saharan Africa, namely South Africa and frontier East African economies. The direct effect on economic activity would likely be muted in commodity exporters, but they would tend to experience a drop in their export receipts, mainly through a reduction in commodity prices.

Figure 1: Impulse Responses to a Positive Shock to the VIX
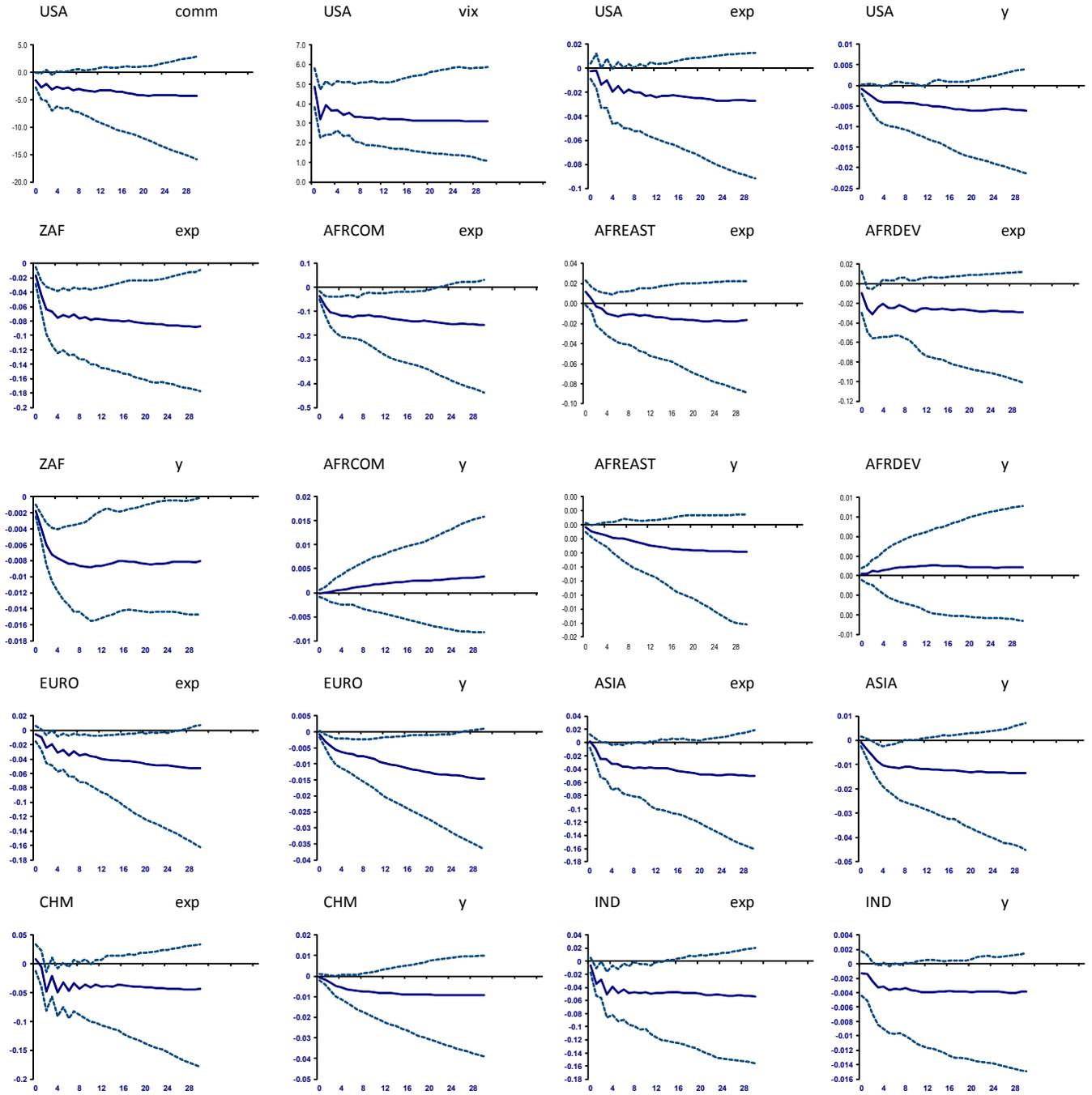
Source: Authors' estimations.

B. The Bank Deleveraging Channel

How did deleveraging in the banking systems of the United States and Europe affect sub-Saharan Africa? During the global financial crisis and its aftermath, stress in banking systems in the United States and Europe led to a sharp reduction in cross border and domestic lending. The persistency of this effect partly reflected regulatory changes after the global financial crisis, which led to a rethinking of financial sector risks in general, and banks' sizes and leverage ratios in particular. Tighter regulation impacted lending operations and considerably reduced the flow of funds, limiting the pool of resources available to the companies and households, both domestically and abroad, that had borrowed from American and European banks to finance consumption and investment.

What do the empirical regularities highlighted in the estimated GVAR model predict in terms of the impact of this deleveraging on sub-Saharan Africa and elsewhere? Our results suggest that there is no significant relationship between a negative shock to credit supply in the U.S. and all the economies (except for Europe) and lending conditions in sub-Saharan Africa. The answer can be read in the impulse responses to a negative shock to local lending in the U.S. or Europe. They suggest that a contraction in lending in the United States would have a pervasive effect in the contraction of lending conditions in a few countries (Figure 2). The largest drop in real credit activity would be seen in OTHER and LATAM, with 0.9 and 0.7 percent, respectively. In sub-Saharan Africa, South Africa would be the most affected with a 0.8 percent reduction in credit, but in all sub-Saharan Africa groupings the point estimates fall well within error bands around zero, which indicates no significant relationship.

The identified relationships for a shock to European credit and its impact on local credit conditions around the world is more uncertain, as can be inferred from the wide error bands (see Figure A1 in the Appendix). One of the possible reasons here is that there is a less strong correlation between bank lending activity in Europe and the cross-border lending behavior of the same banks. If European banks deleveraged by reducing their cross border lending exposure, while at the same time maintain their local credit portfolios constant, no relationship is likely to be picked up.

Figure 2: GIRF – Ones s.e. Negative Shock to Credit in the United States and Impact on Local Credit
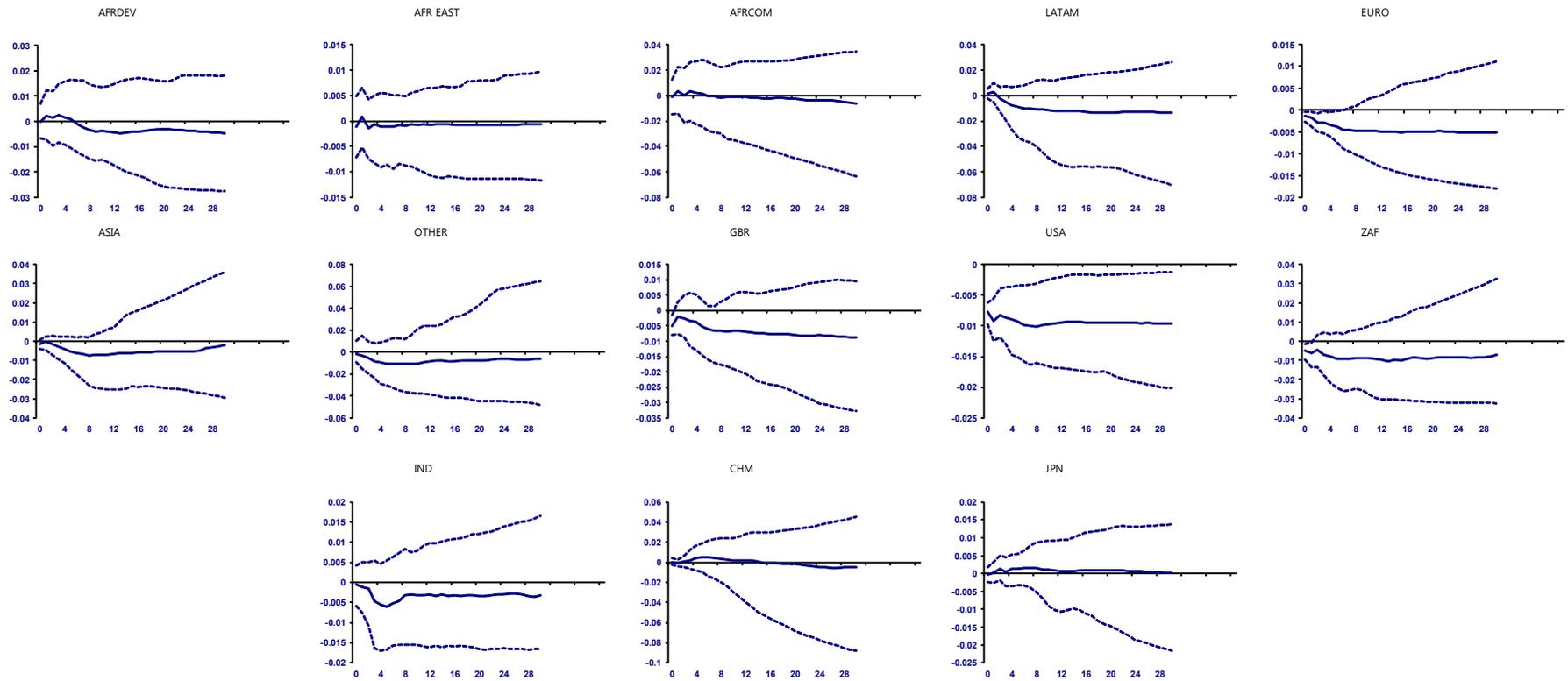
Source: Authors' estimations.

Nevertheless, the direct impact of this credit contraction in the United States on economic activity abroad could be expected to be limited[8] to a few regions only, Europe and South Africa are among them (Figure 3). For sub-Saharan Africa, other than South Africa, the impulse response median estimates are marginally different from zero and the error bands wide and evenly distributed around zero, allowing a rather safe inference that the impact on these country groups is negligible. The results are in general more muted for a shock to European credit.[9] Across most countries and regions the error bands are relatively wide and around zero, indicating a rather weak potential link.

Figure 3: GIRF - One s.e. Negative Shock To Credit in the United States and Impact on Local Output
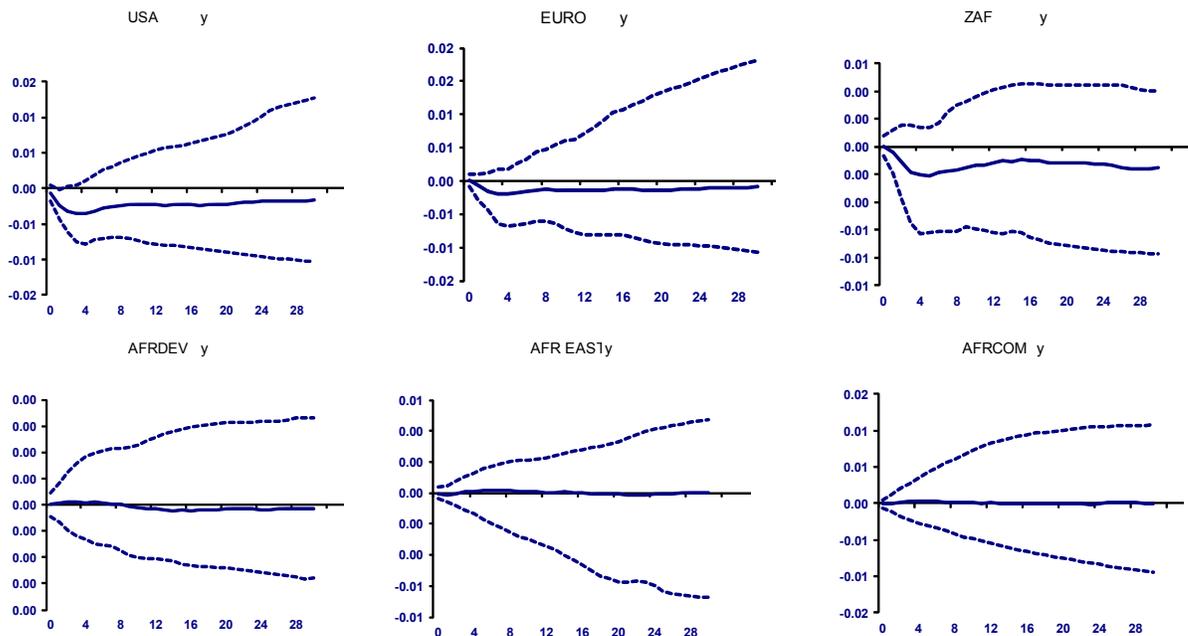
Source: Authors' estimations.

In terms of business cycle synchronicity, Europe seems to play a clearer role compared to the U.S., since error bands are narrower and for a great majority of countries and regions restrict the confidence intervals of the impulse responses to the negative spectrum (Annex B, Figures A2/A3). Various regions are impacted by a negative shock to European output; in sub-Saharan Africa clearly South Africa is the most vulnerable, followed by AFREast, while AFRDEV appears immune and AFRCOM showing a rather weak negative correlation.

Although we find some evidence of systematic impact of global developments in South Africa and the more financially developed countries in East Africa, our results indicate that there is either a non-noticeable or quite weak impact of global financial and macroeconomic

---

[8] For the sake of conciseness we have abstained from presenting the GIRFs here. They are available upon request.

[9] See Annex B, Figure A1

developments on related sectors in less developed and commodity exporting sub-Saharan African counties. The question then is why this is the case, given that quite a few of these countries have a presence of foreign banks or cross border loans, maintain considerable trade ties to the rest of the world, and are affected by the impact of world developments on commodity prices. Tentative explanation, that warrants further analysis, include: first, the financial and investment engagement in those countries is associated with foreign direct investment and other financial arrangements over relatively long horizons (less hot and volatile capital flows); Second, over our specific sample, many countries in the region have resolved violent social conflicts and released the constraints of debt overhang through debt relief initiatives, which may have taken precedence over other global developments in influencing economic activity.

V. CONCLUSION

Sub-Saharan African is not immune to global financial spillovers, but these vary across sub-Saharan African countries and variables. This conclusion can be derived from generalized impulse responses of a GVAR exercise including sub-Saharan African countries and region as well as global financial variables like the Chicago Board of Options Exchange Volatility Index (VIX) and credit conditions in key financial markets like those of the U.S. or the Euro area. In particular, shocks to the VIX affect the external environment that sub-Saharan African countries face, including through commodity prices, external trade, and economic activity in trading partners. The combined effect of lower prices, trade and economic activity in advanced economies (key trading partners for the region) have a strong effect on exports of the region, especially in those that rely heavily on commodities (South Africa and AFRCOM in this paper's classification). But the impact on economic activity is significant only in the more financially developed economies (South Africa and AFREAST). In contrast, shocks to credit conditions in the U.S. or the Euro area do not seem to have a significant effect on sub-Saharan Africa, except in South Africa. This suggests that spillovers from the VIX onto economic activity in sub-Saharan African countries may come from the effect they have on trading partners than any direct effect on economic activity in the region.

REFERENCES

Bussière, M., A. Chudik, and G. Sestieri, 2009, "Modelling global trade flows: results from a GVAR model" Working Paper Series 1087, European Central Bank.

Canales-Kriljenko, J. I., M. Mecagni, and A. Meyer-Cirkel, 2012, "The Impact of Global Financial Stress on Sub-Saharan African Banking Financial Systems" in Sub-Saharan Africa Regional Economic Outlook (Washington D.C.: International Monetary Fund, April).

Cashin, P., K. Mohaddes, and M. Raissi, 2012, "The Global Impact of the Systemic Economies and Mena Business Cycles," IMF Working Paper 12/255.

Cashin, P., K. Mohaddes, M. Raissi, and Maziar Raissi, 2012, "The Differential Effects of Oil Demand and Supply Shocks on the Global Economy," IMF Working Paper, 12/253.

Castrén, O., S. Dées, and F. Zaher, 2010, "Stress-Testing Euro Area Corporate Default Probabilities Using a Global Macroeconomic Model," *Journal of Financial Stability,* 6, 64-78.

Chudik, A., and M. Fratzscher, 2011, "Identifying the Global Transmission of the 2007.2009 Financial Crisis in a GVAR Model," *European Economic Review*, 55, 325-339.

Dées, S., S. Holly, M. H. Pesaran, and L. V. Smith, 2007, Long-run Macroeconomic Relations in the Global Economy. Economics, the Open Access, Open Assessment E-Journal 1. Kiel Institute for the World Economy.

Dees, S., F. D. Mauro, M. H. Pesaran, and L. V. Smith, 2007, "Exploring the International Linkages of the Euro Area: A Global VAR Analysis," *Journal of Applied Econometrics,* 22, 1-38.

Drummond, P., and G. Ramirez, 2009, "Spillovers from the Rest of the World into Sub-Saharan African Countries" IMF Working Paper, 12/49.

Drummond, P., M. Mlachila, G. Salinas, H. Jin, A. Meyer-Cirkel, and T. Trasino, 2010, "Sub-Saharan Africa's Engagement with Emerging Partners: Opportunities and Challenges,' In *Regional Economic Outlook for sub-Saharan Africa* (October).

Favero, C. A., 2013, "Modelling and Forecasting Government Bond Spreads in the Euro Area: A GVAR Model," *Journal of Econometrics* (forthcoming).

Galesi, A., and S. Sgherri, 2009, "Regional Financial Spillovers across Europe: A Global VAR Analysis," IMF Working Paper, WP/09/23.

Gurara, D. Z. and M. Ncube, 2013, "Global Economic Spillovers to Africa- A GVAR Approach," African Development Bank Working Paper 183.

Pesaran, M. H., T. Schuermann, and L. V. Smith, 2009, "Forecasting Economic and Financial Variables with Global VARS," *International Journal of Forecasting*, 25, 642-675.

Pesaran, M. H., T. Schuermann, and S. M. Weiner, 2004, "Modeling Regional Interdependencies Using a Global Error-Correcting Macroeconometric Model," *Journal of Business & Economic Statistics*, 22, 129-162.

Pesaran M. H., Shin Y., 1998, "Generalized impulse response analysis in linear multivariate models." *Economics Letters* 58: 17–29.

Samake, I., and Y. Yang, 2011, "Low-Income Countries. BRIC Linkage: Are There Growth Spillovers?" IMF Working Paper, 11/267.

VI. ANNEX

A. Statistical Properties of the Series

Order of Integration

The traditional ADF tests indicate that most country-specific foreign variables for most regions are integrated of order one. More formally, a unit root hypothesis cannot be rejected at the 5 percent level (Annex Table 1). Weighted Symmetric DF tests generate very similar results and are therefore not reported here, but could be obtained upon request from the authors. The unit root test for the global variables, oil prices, and VIX do not reject non-stationarity at the 5 percent level and can be obtained upon request.

Cointegrating relationships

The estimated number of cointegrating relationships varies between 1 and 3 in most regions. Sub-Saharan African regions had only one cointegrating relationship, except in South Africa, which had two. In the case of AFREAST sub-Saharan African economies the number of cointegrating relationships has been manually reduced from 3 to 1, after carefully analyzing the persistent profile of system-wide shocks to the cointegrating relationships of the GVAR model and running additional cointegrating tests for the individual series separately in EViews. The rank of the cointegrating space in the cointegration VARX models are determined using the error-correction forms of the individual country equations, as laid out in Smith and Galesi (2011). The rank of the cointegrating space is calculated using the Johansen's trace and maximum eigenvalue statistics as laid out in Pesaran, Shin, and Smith (2000) for models with weakly exogenous I(1) regressors. Due to better power properties in small samples, compared to the maximal eigenvalue statistics, the trace statistics is used.

Table 1A: Augmented Dickey-Fuller (ADF) Unit Root Tests for the Domestic Variables at the 5% Significance Level

Domestic Variables	Critical Value	AFRDEV	AFRFRONTIER	AFRCOM	LATAM	EURO	ASIA	OTHER	GBR	USA	ZAF	IND	CHM	JPN
y (with trend)	-3.45	-5.45	-2.00	-2.52	-2.81	-2.33	-3.24	-2.58	-1.45	-0.46	-3.14	-1.61	-2.07	-2.58
y (no trend)	-2.89	3.02	0.94	0.17	0.11	-0.65	-0.84	-0.52	-1.70	-2.40	0.40	1.90	-0.14	-1.37
Δy	-2.89	-2.30	-3.03	-2.39	-5.71	-4.15	-4.89	-5.07	-3.71	-3.45	-4.10	-9.62	-2.07	-5.14
Δ^2y	-2.89	-11.84	-7.89	-6.45	-7.27	-5.55	-6.21	-6.99	-5.81	-6.76	-6.55	-8.88	-8.41	-9.58
i (with trend)	-3.45	-2.82	-4.60	-2.97		-2.74	-4.06	-1.90	-3.32	-3.99	-3.19	-2.30	-1.52	-3.63
i (no trend)	-2.89	-1.25	-1.86	-1.67		-2.43	-2.59	-0.38	-2.10	-1.88	-1.91	-0.97	-0.88	-4.05
Δi	-2.89	-7.38	-8.27	-5.72		-4.23	-5.47	-7.05	-5.41	-3.57	-6.08	-5.28	-4.76	-3.87
Δ^2i	-2.89	-7.71	-6.84	-6.55		-8.77	-10.83	-6.90	-7.50	-5.45	-7.26	-9.86	-7.15	-6.93
len (with trend)	-3.45	-2.53	-2.41	-1.93	-2.07	-4.86	-2.98	-1.44	-1.34	-3.46	-2.53	-1.64	-3.40	-2.04
len (no trend)	-2.89	1.28	-0.26	0.41	-1.19	-1.19	-1.44	0.16	-2.19	-1.35	-0.68	0.75	0.21	-1.57
Δlen	-2.89	-2.20	-4.41	-2.33	-3.39	-0.94	-3.24	-4.64	-1.13	-2.42	-6.14	-3.65	-3.97	-3.14
Δ^2len	-2.89	-8.71	-9.41	-9.30	-4.58	-13.21	-9.70	-8.30	-12.81	-9.54	-7.62	-8.78	-12.46	-12.21
exp (with trend)	-3.45	-3.30	-2.33	-3.35	-4.73	-4.18	-3.51	-2.80	-2.51	-3.29	-2.68	-1.35	-2.99	-4.51
exp (no trend)	-2.89	0.14	-0.79	-0.77	-0.30	-0.52	-0.28	-0.53	-1.03	-0.57	-0.02	0.95	0.61	-1.06
Δexp	-2.89	-10.01	-7.15	-5.00	-4.74	-4.55	-5.21	-3.77	-3.85	-5.17	-7.35	-3.56	-3.21	-5.69
Δ^2exp	-2.89	-7.58	-9.84	-6.45	-5.67	-6.12	-6.07	-14.70	-12.11	-5.53	-11.05	-14.85	-32.71	-9.48

ADF Unit Root Tests for the **Foreign** Variables at the 5% Significance Level

Foreign Variables	Critical Value	AFRDEV	AFRFRONTIER	AFRCOM	LATAM	EURO	ASIA	OTHER	GBR	USA	ZAF	IND	CHM	JPN
y* (with trend)	-3.45	-2.83	-1.39	-1.88	-0.92	-2.42	-2.49	-2.88	-2.36	-3.51	-2.55	-2.26	-2.05	-2.88
y* (no trend)	-2.89	0.15	-1.32	-1.22	-1.86	-1.43	-1.07	-0.87	-0.91	-0.47	-0.91	-1.26	-1.46	-1.35
Δy*	-2.89	-4.98	-4.10	-4.28	-3.74	-4.59	-5.10	-4.71	-4.43	-5.34	-4.60	-5.04	-4.90	-5.10
Δ^2y*	-2.89	-9.60	-5.58	-7.53	-6.91	-7.34	-8.68	-7.87	-5.61	-8.18	-7.65	-6.91	-7.58	-7.57
i* (with trend)	-3.45	-3.39	-2.87	-3.54	-3.84	-2.82	-3.11	-3.08	-3.12	-4.26	-2.65	-3.21	-2.67	-3.29
i* (no trend)	-2.89	-1.05	-1.53	-0.95	-1.36	-0.51	-0.94	-1.66	-1.37	-1.36	-1.35	-0.92	-1.40	-1.21
Δi*	-2.89	-4.68	-4.57	-3.82	-3.52	-4.20	-3.48	-5.15	-4.46	-5.55	-5.13	-4.69	-4.67	-4.78
Δ^2i*	-2.89	-9.16	-8.65	-9.43	-5.73	-11.25	-10.42	-6.22	-9.70	-5.87	-10.00	-11.76	-10.36	-11.56
len* (with trend)	-3.45	-2.72	-1.70	-2.06	-3.38	-2.27	-2.41	-2.97	-3.05	-2.23	-3.03	-2.82	-2.59	-2.23
len* (no trend)	-2.89	-1.06	-2.55	-0.90	-1.43	-0.96	0.62	-1.07	-1.54	-0.35	-1.43	-0.74	-0.47	-0.47
Δlen*	-2.89	-1.67	-0.77	-2.01	-2.16	-2.18	-6.26	-2.02	-1.36	-3.35	-1.44	-4.64	-4.87	-4.54
Δ^2len*	-2.89	-12.32	-12.52	-10.46	-10.10	-9.80	-9.61	-10.28	-12.37	-7.42	-12.64	-8.84	-9.09	-7.76
exp* (with trend)	-3.45	-3.74	-3.96	-4.12	-3.62	-4.11	-4.54	-4.28	-4.45	-4.73	-4.28	-4.23	-4.00	-4.23
exp* (no trend)	-2.89	0.08	-0.38	-0.05	-0.31	-0.22	0.12	-0.09	-0.12	-0.14	-0.17	-0.11	-0.28	0.09
Δexp*	-2.89	-5.29	-4.65	-5.24	-5.16	-4.93	-4.91	-5.60	-5.26	-5.42	-5.57	-5.20	-5.92	-4.68
Δ^2exp*	-2.89	-6.56	-6.22	-5.83	-5.63	-5.51	-5.21	-6.67	-6.18	-5.61	-6.25	-5.60	-6.58	-5.28

1/ Selected acronyms include Sub-Saharan Africa Developing (AFRDEV), Sub-Saharan Africa Frontier (AFRFRONTIER), Sub-Saharan Africa Commodity Exporters (AFRCOM), Latin America (LATAM), South Africa (ZAF).

Source: Authors' estimations.

Table 2A: VARX Order of Individual Models and Cointegrating Relationships [1,2]

	p	q	# Cointegrating relations
AFRDEV	2	1	1
AFRFRONTIER	2	1	1
AFRCOM	2	1	1
LATAM	2	1	3
EURO	1	1	2
ASIA	2	1	1
OTHER	2	1	1
GBR	2	1	2
USA	2	1	1
ZAF	2	1	2
IND	2	1	2
CHM	1	1	3
JPN	2	1	3

[1] p = lag order of domestic variables, q = lag order of foreign variables

[2] Selected acronyms include SSA developing (AFRDEV), SSA frontier (AFRFRONTIER), SSA commodity exporters (AFRCOM), Latin America (LATAM), South Africa (ZAF).

Source: Authors' estimations.

Weak exogeneity test

The assumption of weak exogeneity of the foreign variables implies that domestic variables do not affect foreign variables in the long-term, although they may affect them in the short run. Here we use the test suggest by Johansen (1992) and Harbo, Johansen, Nielsen and Rahbeck (1998). In particular, we consider the following regression

$$\Delta x_{it,l}^* = \mu_{i,l} + \sum_{j=1}^{r_i} \varphi_{ij,l} ECM_{ij,t-1} + \sum_{j=1}^{r_i} \delta_{ik,l} \Delta x_{i,t-k} + \xi_{i,l} \Delta x^*_{i,t-1} + \vartheta_{it,l}$$

whereby $ECM_{ij,t-1}$ are the estimated error-correction terms related to the jth, j = 1, ..., r_i, identified cointegration relationships, with r_i being the number of cointegrating relationships for each country i. Further, $\Delta x_{it,l}^*$ is the difference of the lth element of the foreign variable x_{it}^* for country i at time t. In this regression framework if $\varphi_{ij,l} = 0$ for j=1,…, r_i jointly, for all possible values of l, then foreign variables will be weakly exogenous.[10] We test for this joint hypothesis using an F-test.

Most foreign and global variables are weakly exogenous (Table 5). More formally, the assumption of weak exogeneity is not rejected in 95 percent of all the 76 possible cases. The three exceptions are interest rates for the U.K. and the VIX for the euro area and AFRCOM commodity exporters. This suggests that the U.K. may have an effect on global interest rates and that developments in the Euro area and commodity exporters may have some effect on global investor uncertainty.

---

[10] We use the same regression framework to test whether the global variables are exogenous for each country/regions (except for the U.S.).

Table 3A: Test for Weak Exogeneity (5% Significance Level)

Country\Region1	F test	Fcrit 5%	y*	i*	len*	exp*	comm	vix
AFRDEV	F(1,62)	4.00	1.93	0.07	0.70	0.29	0.00	0.62
AFR EAST	F(1,62)	4.00	0.38	1.08	1.95	0.08	0.13	3.89
AFRCOM	F(1,62)	4.00	0.57	0.13	0.03	3.01	1.31	4.93
LATAM	F(3,62)	2.75	0.68	0.69	0.31	1.57	0.61	1.67
EURO	F(2,65)	3.14	0.98	0.72	2.02	1.62	2.45	8.35
ASIA	F(1,62)	4.00	0.33	0.75	0.11	0.09	0.10	0.17
OTHER	F(1,62)	4.00	0.62	0.81	0.09	0.49	0.05	2.37
GBR	F(2,61)	3.15	0.67	4.17	2.02	0.00	3.03	1.96
USA	F(1,60)	4.00	0.92	0.00	0.00	0.00		
ZAF	F(2,61)	3.15	1.06	0.38	0.30	2.61	1.46	1.73
IND	F(2,61)	3.15	2.12	0.53	0.28	0.99	1.09	0.51
CHM	F(3,64)	2.75	0.57	0.19	0.82	0.95	1.88	1.01
JPN	F(3,60)	2.76	1.01	0.74	0.05	1.27	1.29	1.12

1/ Selected acronyms include Sub-Saharan Africa Developing (AFRDEV), Sub-Saharan Africa Frontier (AFRFRONTIER), Sub-Saharan Africa Commodity Exporters (AFRCOM), Latin America (LATAM), South Africa (ZAF)

Source: Authors' estimations.

B.   Additional Results

Figure 1A: GIRF – One s.e. Negative Shock to Credit in EUR and Impact on Local Credit
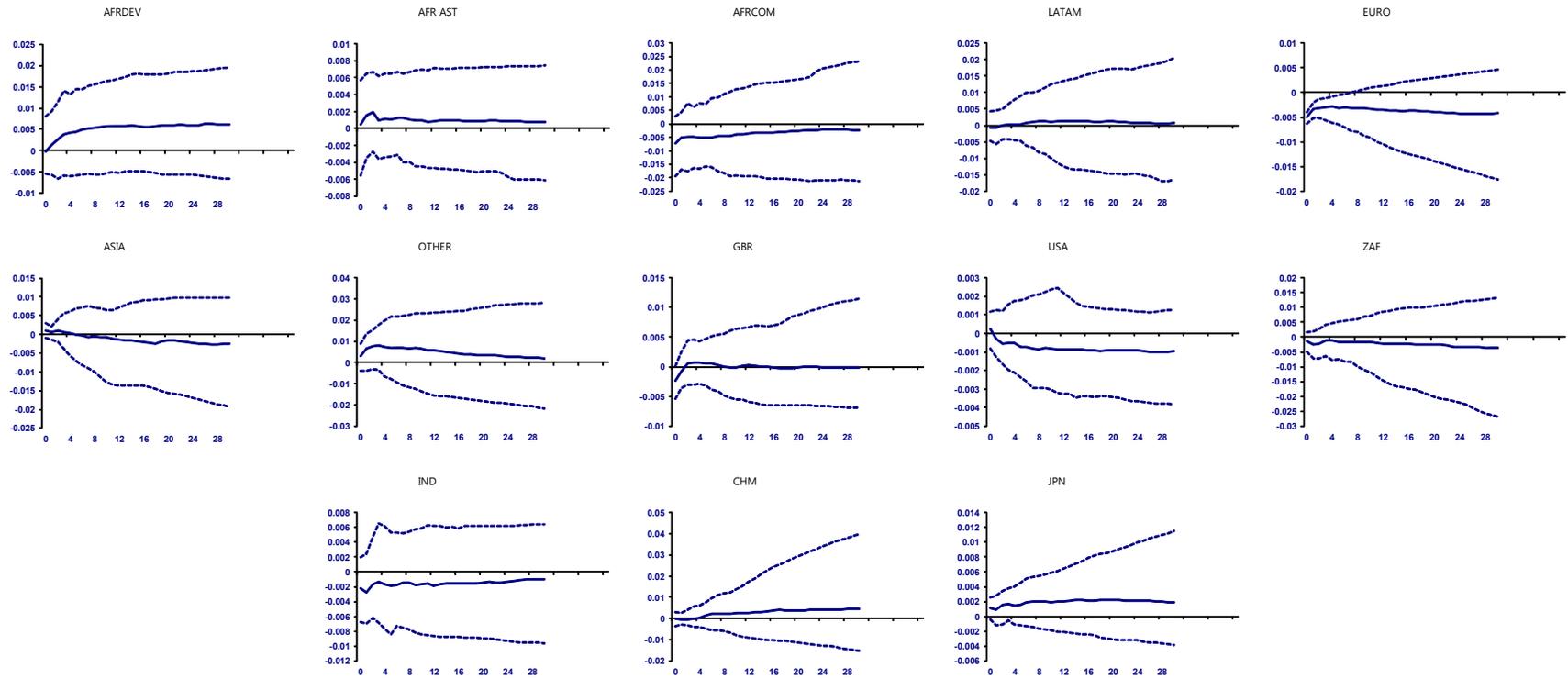

Source: Authors' estimations.

Figure 2A: GIRF – One s.e. Negative Shock to Output in EUR and Impact on Local Output
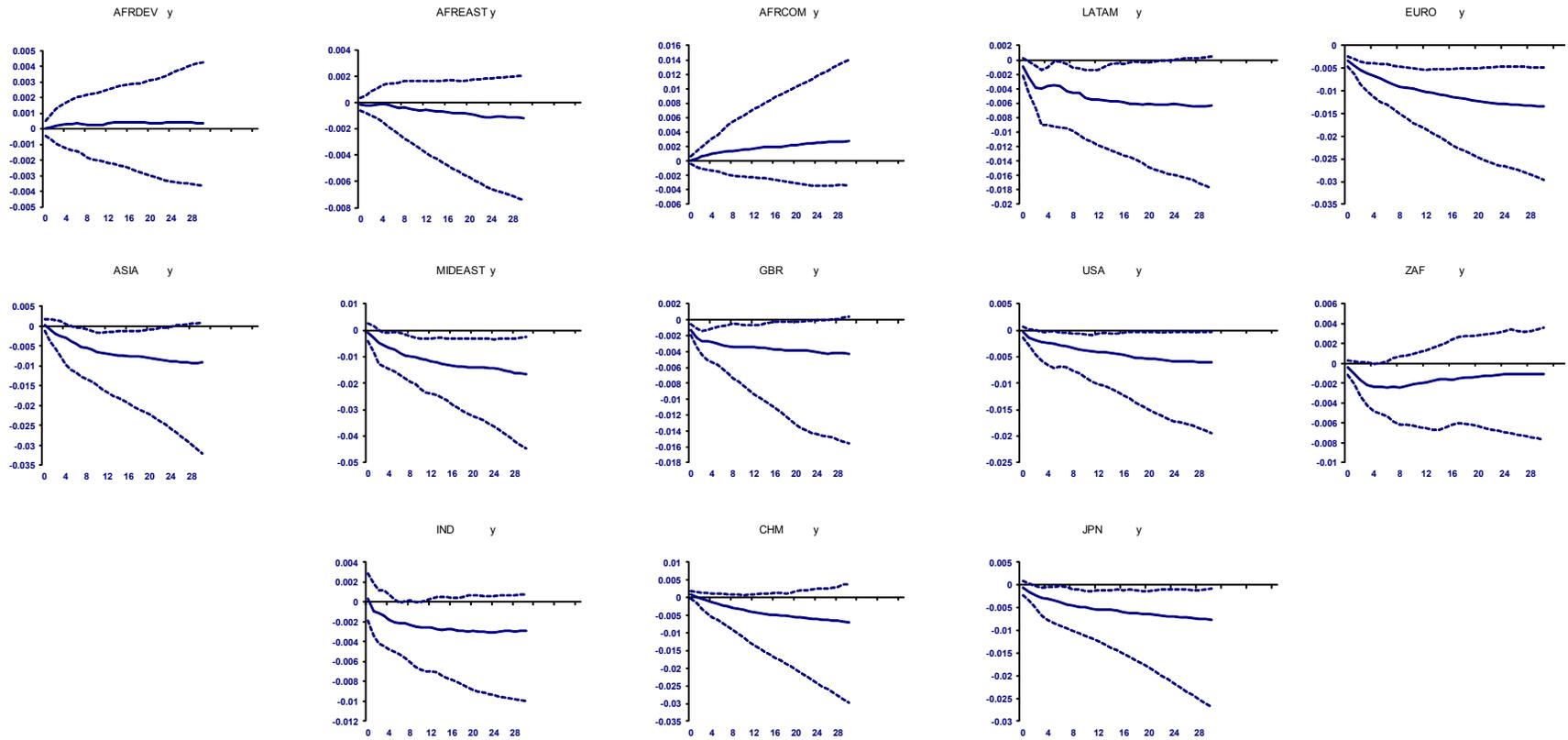

Source: Authors' estimations

Figure 3A: GIRF – One s.e. Negative Shock to Output in USA and Impact on Local Output
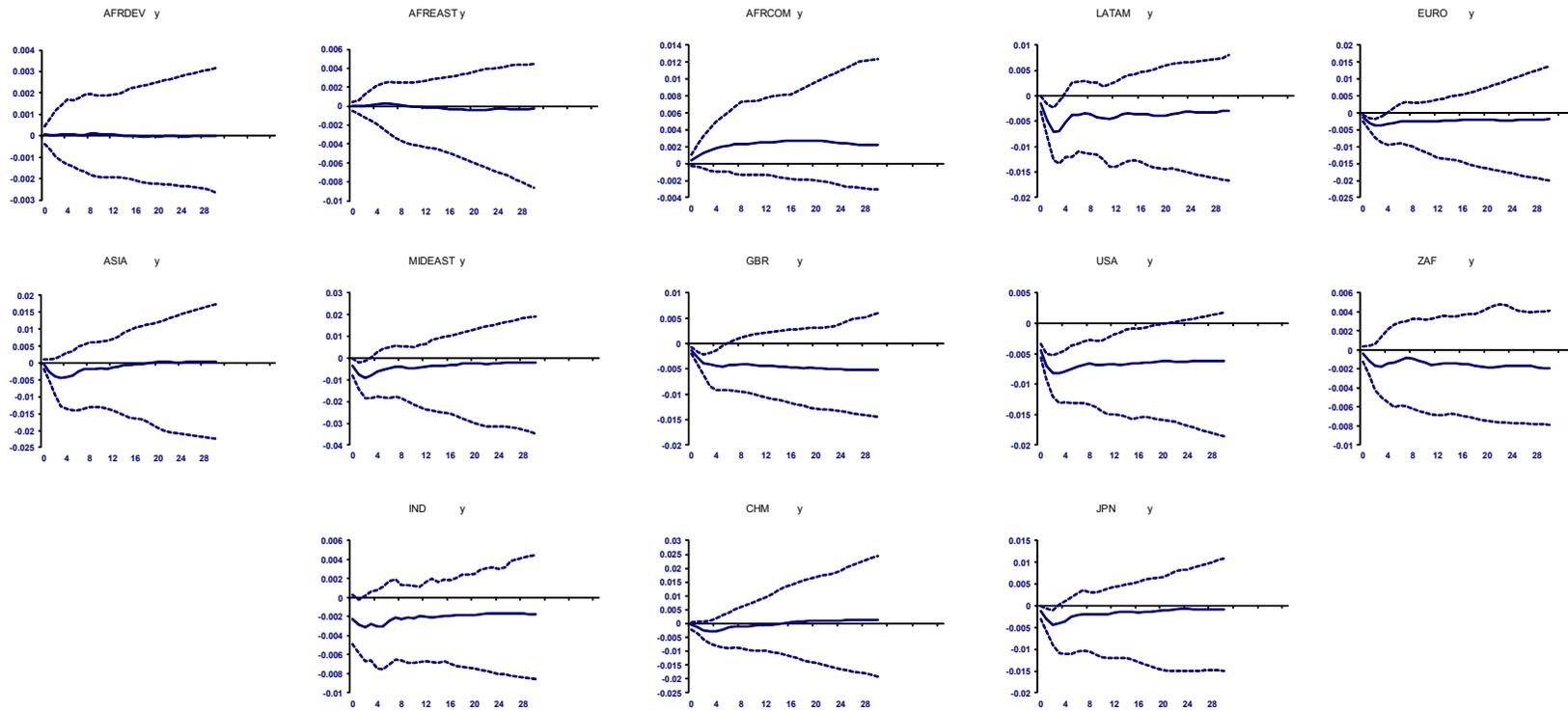
Source: Authors' estimations

Table 4A: Regional and country-level export shares :1990–2000

Export Destination	Export Origin												
	SSA Developing	SSA East Afr.	SSA Comm. Exporters	Latin America	Europe	Asia	Other	UK	USA	S. Africa	India	China	Japan
SSA Devel.	.	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
SSA Frontier	0.00	.	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
SSA Comm. Exporters	0.05	0.00	.	0.00	0.02	0.00	0.00	0.00	0.01	0.01	0.06	0.00	0.00
Latin America	0.01	0.01	0.04	.	0.05	0.02	0.02	0.02	0.17	0.03	0.02	0.03	0.03
Europe	0.53	0.31	0.46	0.24	.	0.15	0.49	0.55	0.31	0.37	0.21	0.18	0.14
Asia	0.08	0.12	0.09	0.04	0.11	.	0.07	0.08	0.15	0.06	0.23	0.27	0.30
Other	0.00	0.01	0.00	0.00	0.03	0.01	.	0.01	0.01	0.01	0.06	0.00	0.01
UK	0.08	0.18	0.13	0.02	0.32	0.04	0.11	.	0.06	0.16	0.12	0.02	0.03
USA	0.07	0.07	0.14	0.63	0.25	0.29	0.19	0.21	.	0.18	0.15	0.18	0.33
S. Africa	0.03	0.06	0.01	0.00	0.00	0.00	0.00	0.00	0.00	.	0.01	0.00	0.00
India	0.03	0.09	0.03	0.00	0.01	0.01	0.01	0.01	0.01	0.01	.	0.01	0.01
China	0.08	0.05	0.03	0.01	0.04	0.07	0.02	0.02	0.05	0.03	0.03	.	0.14
Japan	0.04	0.10	0.06	0.06	0.15	0.41	0.08	0.09	0.23	0.13	0.11	0.31	.

Source: IMF, Direction of Trade Statistics (DOTS)