WP/15/221

IMF Working Paper

Spillovers from China onto Sub-Saharan Africa: Insights from the Flexible System of Global Models (FSGM)

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INTERNATIONAL MONETARY FUND

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African Department and Research Department

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Authorized for distribution by Hervé Joly and Benjamin Hunt

August 2015

Abstract

What is the impact of economic spillovers from China on sub-Saharan Africa (SSA)? This is an increasingly important question because of China's growing economic role as a partner of SSA countriesfor both trade and the buildup of infrastructure in the region. The impact of spillovers from China has been an open question because of the challenge to use an internally consistent framework with solid economic foundations that accounts for both the direct impact China may have on individual countries in SSA through a variety of channels (trade, investment, financial) as well as the impact on the region through the global economy (economic activity and commodity prices). This paper explores those channels of transmission and provides illustrative order of magnitude for the short- and medium-term economic impact by using AFRMOD, a module of the Flexible System of Global Models (FSGM), a multicountry general equilibrium model developed at the IMF. Three alternative scenarios are considered: first, lower potential output in China that is originally misperceived as a temporary cyclical slowdown; second, structural reforms in China that aim to increase potential output; and third, a relocation of low-end manufacturing to sub-Saharan Africa.

JEL Classification Numbers: E12; E17; E52; F41; F47; F62

Keywords: Spillovers; monetary policy; general equilibrium models; macroeconomic interdepedence; China; Africa

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I. OVERVIEW

China's linkages with sub-Saharan Africa (SSA) have grown stronger over the last 15 years. China has become sub-Saharan Africa's main trading partner and an important source of foreign direct investment, as well as concessional and non-concessional loans. Chinese companies have also become directly involved in the buildup of infrastructure in the region, sometimes using other cross border sources of funding. All this has taken place during a period in which China has become a key global player as the most interconnected country in world trade.

Not surprisingly, developments in China have an increasingly important effect on sub-Saharan African countries through different channels. These channels include China's direct impact as a trading partner and source of financing and investment, but also its indirect effects through its impact on the global economy's economic activity, real global commodity prices, and global interest rates.

Properly assessing the impact of developments in China on sub-Saharan Africa requires an internally consistent framework with solid economic foundations. Such a framework should be able to distinguish the impact that China may have on the global economy from that it may have on individual countries. It should take into consideration the linkages that exist among countries at the level of trade and financial connections. It should also factor in decisions that individuals may make when facing changes in their environment, as well as their policy regimes and policy responses.

This paper provides model-based simulations that can shed light on the impact of developments in China on sub-Saharan Africa, using AFRMOD, a module of the Flexible System of Global Models (FSGM), a multicountry general equilibrium model developed by the IMF Research Department (Andrle and others, 2015). This paper's contributions are three-fold:

- First, the paper briefly reviews the trade and financial linkages between China and sub-Saharan Africa and summarizes the empirical literature on the linkages between China and sub-Saharan Africa.

- Second, the paper uses a model to analyze channels of transmission and spillovers between China and Africa. These channels include the direct impact from China but also third-country effects, i.e., the impact from China on sub-Saharan Africa through the rest of the world. Country-specific conditions contribute to the final outcome in each country, including the size and composition of trade, monetary, exchange, and fiscal frameworks and policy responses, and the level of indebtedness, among others.

- Third, the paper presents the impact from three specific scenarios on sub-Saharan Africa, based on assumptions about shocks that could emanate from China: first, a reduction in potential output in China initially misperceived as a cyclical downturn; second, a medium-term package of reforms in China that strive to increase potential output in the medium to long term; and, third, a relocation of low-end manufacturing to sub-Saharan Africa from China.

The paper main findings with regards to the three scenarios are as follows:

- Lower potential output in China, temporarily misperceived as a cyclical slowdown, spills over onto sub-Saharan Africa through direct and indirect real and financial channels given China's key role in the global economy and commodity markets, as well as direct close ties with the region. The spillovers vary within SSA, driven by whether a country is commodity exporter or importer. The misperception about potential output imposes larger adjustment costs that last longer and are delayed by several years than would otherwise exist, particularly for SSA commodity exporters.

  In our illustrative simulation, the permanent decline in global real GDP is 1.6 percent lower compared to baseline, while real oil prices end up lower by almost 8 percent. While the overall impact on the sub-Saharan Africa commodity exporters is negative, at about -0.5 percent of baseline real GDP, the net effect on economic activity on sub-Saharan Africa commodity importers is near zero because of the positive effect of lower global commodity prices.

- Reforms in China that come at an initial cost in terms of lost economic activity and that pay off in the medium to long term. In the longer term, such reforms are beneficial for sub-Saharan Africa. It provides commodity goods, for which it receives higher prices from increased demand. SSA imports a large share of its goods (particularly investment goods) from China, which are now cheaper because of China's productivity-enhancing reforms. These reforms in China could be considered as a way to offset the negative impact on sub-Saharan Africa from the lower potential output in China mentioned in the first scenario.

  In our illustrative simulation, the reforms result in a short-to-medium term decline of about 1 percent in Chinese economic activity relative to baseline, which pays handsomely in the long term with a rise of about 25 percent over baseline. As a result, oil prices end up roughly 15 percent higher. In the long term, the Chinese reforms benefit the commodity exporters in sub-Saharan Africa by about 1 percent of real GDP, but they would benefit little commodity importers, because of the offsetting effects from global commodity prices.

- A potential relocation of Chinese exporters to sub-Saharan Africa, in a context of rising labor costs in China, can also have significant implications for the region, with significant gains across countries and improved linkages to the global economy. The relocation has minimal impact on China or the world economy, but would help boost sub-Saharan Africa's economic activity and income. In our illustrative simulation, sub-Saharan Africa's economic activity rises by about 4 percent over baseline after about 10 years.

As a word of caution, though, while the paper aims to highlight the channels of transmission within an internally consistent macroeconomic framework that allows for policy responses, it does not attempt to interpret historic results or to make forecasts for the countries analyzed.

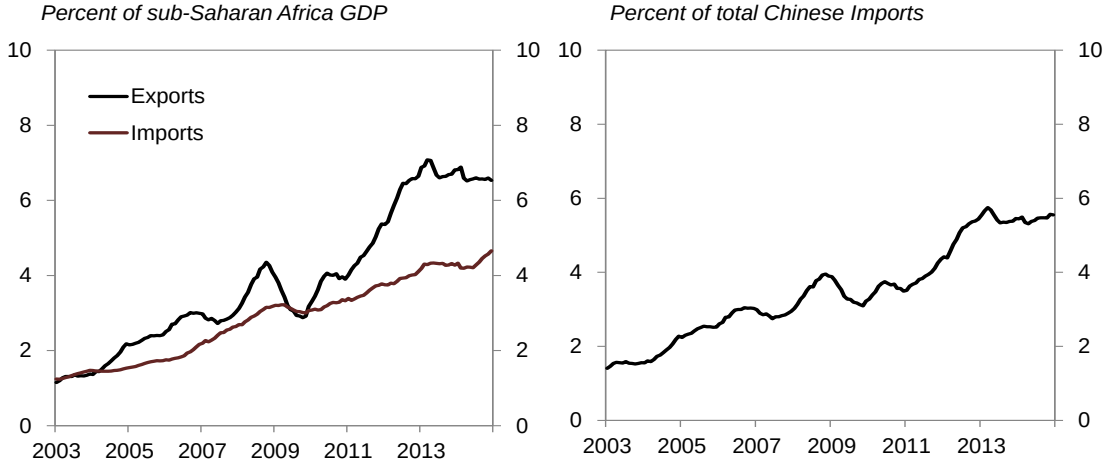
The paper is organized as follows: Section II provides an overview of economic linkages between China and sub-Saharan Africa. Section III examines developments in China that could affect the region and briefly describes the three economic scenarios in this paper: lower potential output, structural reforms, and relocation of Chinese firms to sub-Saharan Africa. Section IV reviews the evidence of spillovers from China onto sub-Saharan Africa. Section V gives a succinct overview of AFRMOD, the sub-Saharan Africa module of FSGM. Sections VI, VII and VIII present the three scenarios. Section IX concludes.

II. Linkages Between China and Sub-Saharan Africa

China has become a major player in the development of sub-Saharan Africa. Its brisk growth and resulting demand for oil and other commodities has propelled trade with resource-abundant countries in sub-Saharan Africa. China has become both the top destination of exports and top source of imports for many sub-Saharan African countries.

SSA's trade with China has grown significantly faster than world trade. According to the IMF's Direction of Trade Statistics, bilateral trade in goods rose from US$16.7 billion in 2005 to an estimated US$109 billion in 2014, driven in part by China's increasing demand for natural resources. During this period, sub-Saharan African exports to China have trebled from about 2.4 percent to 6.5 percent of the region's GDP. A large proportion of the export growth is explained by oil, but other exports also grew significantly, on average by 30 percent annually. To promote China-SSA trade further, China has exempted from tariffs 60 percent of goods imported from 30 African countries since 2012. On the other hand, sub-Saharan Africa has also increased its share in total Chinese imports to almost 6 percent from less than 2 percent (Figure 1).

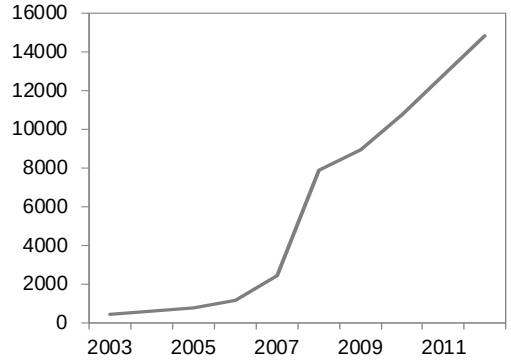
Figure 1. Sub-Saharan Africa's Exports to China, 2003-2014



Source: IMF, Direction of Trade Statistics and World Economic Outlook databases.

Chinese FDI has been mostly allocated to the natural resource and infrastructure sectors. Chinese FDI stocks rose to about US$15 billion in 2012 (Figure 2), and annual flows reached US$2 billion or about 12 percent of total FDI to the region. In 2012, Chinese enterprises completed project contracts worth about $40 billion with SSA partners for construction, roads, bridges and ports, water conservation and electricity. In addition, China has been involved in six special economic zones in four countries in SSA (2 each in Nigeria and Zambia, one each in Ethiopia and Mauritius, respectively), promoting manufacturing clusters.

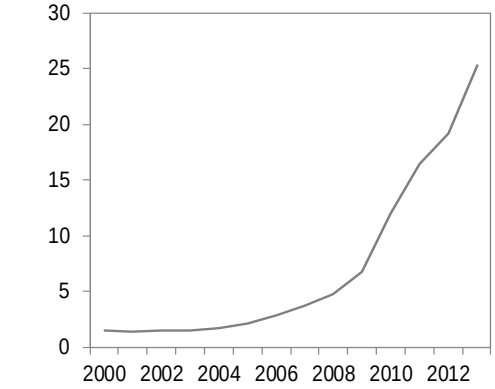
Figure 2. China's Cummulative Foreign Direct Investment in sub-Saharan Africa: 2003-2012
Millions of U.S. dollars



Source: UNCTAD.

Between 2010 and 2012, China's aid to Africa reached about US$7.5 billion in the form of grants, interest-free loans and concessional loans according to the 2014 China Foreign Aid report (Information Office of the State Council, 2014). Total loans from China to sub-Saharan Africa, including non-concessional loans, amounted to about US$25 billion by 2013 (Figure 3). Grants account for about a third of China's foreign assistance and focus on building small or medium-sized social welfare projects, and to fund human resources development cooperation, technical cooperation, material assistance and emergency humanitarian aid. China's aid program provides interest-free and other concessional loans for the wholesale construction or repair of government infrastructure and, technical assistance projects, especially in agriculture. From 2010 to 2012, China built in Africa 86 economic infrastructure projects and in 2012, China announced the establishment of construction cooperation partnership with African countries for building infrastructure across countries and sub-regions in sub-Saharan Africa.

Figure 3. China's Loans to Sub-Saharan Africa: 2000-2013
Billions of U.S. dollars

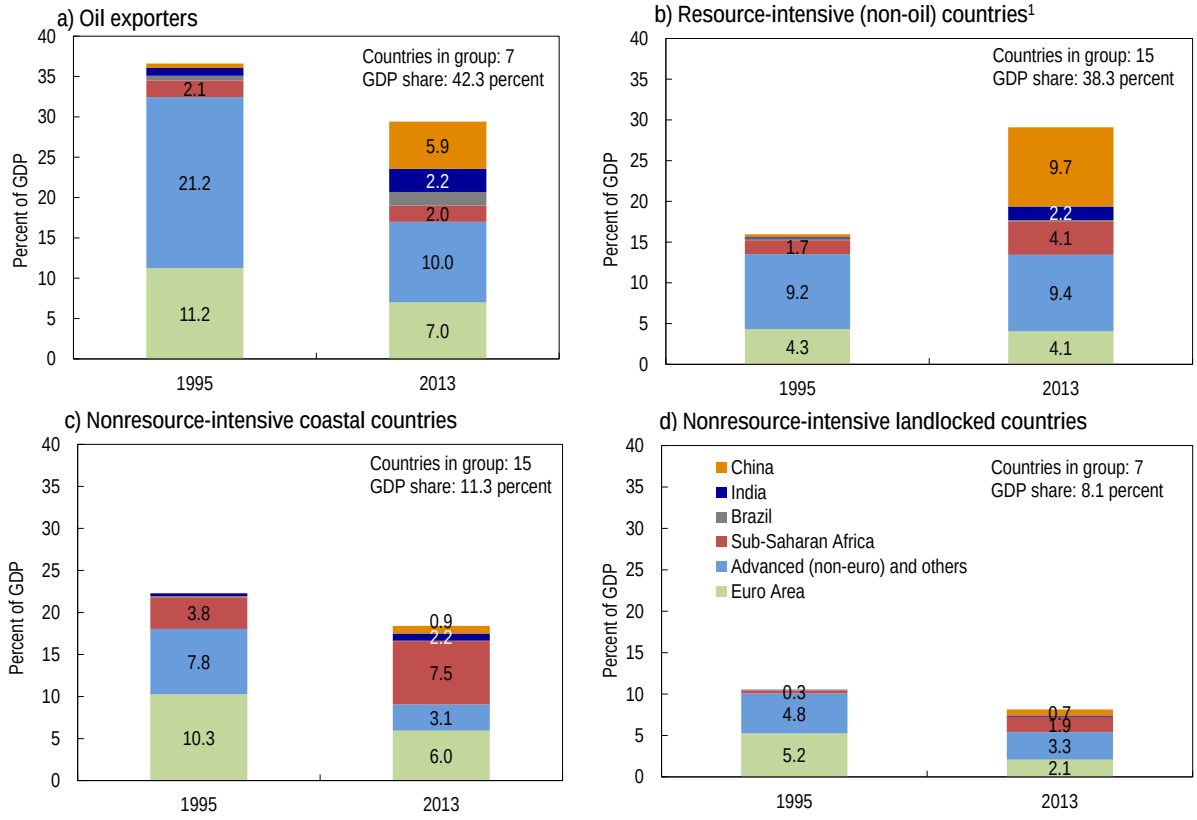


Source: World Bank.

While trade between China and sub-Saharan Africa has increased substantially, so has world trade in general (Figure 4). Sub-Saharan African economies have also grown significantly and have been for almost a decade the second fastest growing region, after developing Asia. Over the last fifteen years, exports have increased as a percentage of GDP in resource intensive non-oil economies, but decreased elsewhere. The share of China has increased significantly in commodity exporters both as a percent of exports and as a percent of GDP.

The effect of China on SSA commodity exporters is thus likely to be stronger than for SSA commodity importers for three main reasons. First, trade is a more important part of the economy in commodity exporting economies. Second, China is a much larger fraction of that trade in commodity exporters than in commodity importers. Finally, export prices tend to move in the same direction as economic activity in China for commodity exporting countries, and in the opposite direction for commodity importing countries.

Figure 4. Sub-Saharan Africa: Exports of Goods, Shares by Partner, 1995 versus 2013



Source: IMF, *Direction of Trade Statistics.*

Note: Excludes South Sudan due to data availability. Oil rich sub-Saharan Africa includes Angola, Cameroon, Chad,Republic of the Congf, Equatorial Guinea, Gabon,and Nigeria. Resource-intensive sub-Saharan Africa includes Botswana, Burkina Faso, Central African Republic, Democratic Republi of the Congc,· Ghana, Guinea ,Liberia, Mali, Namibia, Niger, Sierra Leone, South Africa, Tanzania, Zambia, and Zimbabwe. Nonresource-intensive coastal sub-Saharan Africa includes Benin, Cabo Verde, Comoros, Côte d"Ivoire, Eritrea,The Gambie, Guinea-Bissau, Kenya, Madagascar, Mauritius, Mozambique, São Tomé and Príncipe, Senegal, Seychelles, and Togo. Nonresource-intensive landlockked sub-Saharan Africa includes Burundi, Ethiopia, Lesotho, Malawi, Rwanda, Swaziland, and Uganda.

[1] Resource-intensive countries are defined as those for which nonrenewable resource exports are 25 percent or more of goods exports.

III. Developments in China that Could Affect Sub-Saharan Africa

Because linkages between China and sub-Saharan Africa have become stronger, developments in China are more likely to spillover onto the region.The nature of the shocks that affect the Chinese economy determine how the shocks are propagated and what impact they have on sub-Saharan Africa in general and onto each economy in SSA in particular. This propagation depends, among other things, on the strength of each of the linkages and the size of the shock impacting China.

This paper focuses on three spillover scenarios from China that could affect sub-Saharan Africa:

- Frst, a "*lower potential output in China"* scenario, initially perceived as a cyclical slowdown.

- Second, a "*China rebalancing"* scenario through economic reforms.

- Third, a "*relocation of Chinese firms to sub-Saharan Africa"* scenario, which leads to higher productivity and contributions to global trade in SSA.

The *"Lower Potential Output in China"* scenario is motivated by the experience of the last five years (2009-2014) in which growth forecasts for China (and most other countries around the world) have been systematically revised down each year. The scenario assumes a downward growth revision in China that comes as a surprise which firms and households interpret initially as resulting from a temporary shock to investment, similar to the scenario identified in IMF (2014), but with a greater magnitude. Gradually, however, they realize that rather than an exogenous and temporary reduction on investment, the lower growth (and investment) reflect weaker productivity in the economy. The scenario captures the recent gradual revisions in growth forecasts for China and the view that the path for potential output may be lower than originally expected. It also captures, within a perfect foresight framework, the observation that households and firms frequently reassess their views of the future based on the reality they observe. Rather than mistakes, these behaviors reflect rational updating of expectations.

The "*China Rebalancing*" scenario is based on the global effects of selected economic reforms for China (Lam and Maliszewski, 2015), and motivated by the *Third Plenum* decision adopted in 2013 to undertake such reforms in China. These reforms are expected to rebalance the composition of growth in China toward consumption and away from investment. The scenario assesses the impact of some of those reforms in China on sub-Saharan African countries. In the long run, the reforms would tend to increase the level of potential output in China, albeit with a transitional decline in economic activity.

The *"Relocation of Chinese Firms"* scenario is motivated by the observation that wages in China have been rising rapidly, albeit from a very low level. Although this has improved living standards in China, it has also tended to erode external competitiveness, especially in some areas of manufacturing. Given experience elsewhere, the expectation is that this can create incentives for some industries to move offshore, which is easier for manufacturing activities requiring only basic skills. We assume that part of this relocation involves sub-Saharan Africa, in which China could expand its current presence in sub-Saharan Africa's pilot special economic zones, or encourage creation of new ones.

IV. Previous Evidence of Spillovers from China onto Sub-Saharan Africa

Several authors have attempted to provide estimates of the impact of spillovers from China on sub-Saharan Africa:

- Bandara (2012) uses a GMM estimator to estimate an endogenous growth model using a set of unbalanced panel data for 44 Sub-Saharan African countries covering the period 1970-2009. He finds that Sub-Saharan African countries' exports to China, and FDI from China, have an impact on African countries' economic growth and that the impact of other countries on sub-Saharan Africa becomes smaller in their more recent sample period. They also find that exports to China appear to have a stronger influence on economic growth in countries which receive Chinese FDI than the rest.

- Busse and others (2014) used panel data analysis to study the impact of Chinese trade, FDI, and aid on African real GDP per capita growth rates. After controlling for terms of trade and domestic investment levels, and including simultaneously Chinese trade, FDI, and aid among the regressors, they find that only imports from China seemed to matter, but with a negative impact on growth, a finding they claim is robust to using different samples and period averages as well as an instrumental variable approach. In some specifications, total exports to China and exports of natural resources to China were statistically significant when interacted to terms of trade.

- Drummond and Liu (2013) estimate that a 1 percentage point increase in China's domestic investment growth is associated with an average 0.6 percentage point increase in SSA countries' export growth. This impact is larger for resource-rich countries, especially oil exporters. They note that although rising trading links with China have allowed African countries to diversify trading partners away from advanced economies, they have also led SSA countries to become more susceptible to spillovers from China.

- Ruch (2013) provides evidence that China has contributed to spillovers on South African industrial production, although the correlation with industrial production turned negative after the global financial crisis.

- Zerfu Gurara and Ncube (2013) included China and many sub-Saharan African countries in a global vector autoregression model, explaining spillovers within a GVAR approach, although they stopped short of analyzing the impact of shocks emanating from China on the region. The same is true of the paper of Canales Kriljenko, Hosseinkouchack and Meyer-Cirkel (2014) that focused on financial sector spillovers. This partly reflects the fact that the GVAR approach captures spillovers in the data over long horizons and the exposure of the region to China is a relatively recent phenomenom.

Although these studies generally provide evidence of spillovers from China into sub-Saharan Africa, China's linkages with the region have increased dramatically in recent years. The resulting large changes in the size of cross border linkages suggest that econometric evidence based on long historical data series could severely underestimate the magnitude of Chinese spillovers into sub-Saharan Africa.

V. Overview of the Sub-Saharan Africa Module of the Flexible System of Global Models

Rather than following an econometric approach in this paper, we focus on a macro-modeling approach that clearly describes the changing external environment and how households,

firms and policy makers react to it, taking into consideration the structure of the economy. Our framework explicitly factors in the trade and financial interlinkages, not only directly between China and sub-Saharan African economies, but also indirectly through the direct trade and financial effects China may have on the rest of the world. Another necessary and important component for such a framework is the need to explicitly consider the effect that developments in China have on commodity markets, given the increasingly important role that China has played in those markets, and the importance of commodity prices to many sub-Saharan African economies.

With these linkages determining the external environment for sub-Saharan African economies, in the form of the external demand they face, the prevailing and forthcoming commodity prices and global interest rates, the framework we have sought factors in decisions from households, firms, and fiscal and monetary authorities given prevailing policy frameworks in place in sub-Saharan Africa. These joint decisions in how to respond to the changing external environment then determine consumption, investment, and ultimately real GDP in these economies (Figure 5).

Flexible System of Global Models (FSGM), the Sub-Saharan Africa Module

AFRMOD, one of 9 modules from the Flexible System of Global Models (FSGM) implements this framework. FSGM was developed by the Economic Modeling Division of the IMF for policy analysis (Andrle and others, 2015).It is a complete representation of the world economy that is an annual, semi-structural, dynamic general equilibrium macroeconomic model.Some equations are supported by micro-foundations and others by reduced-form representations.

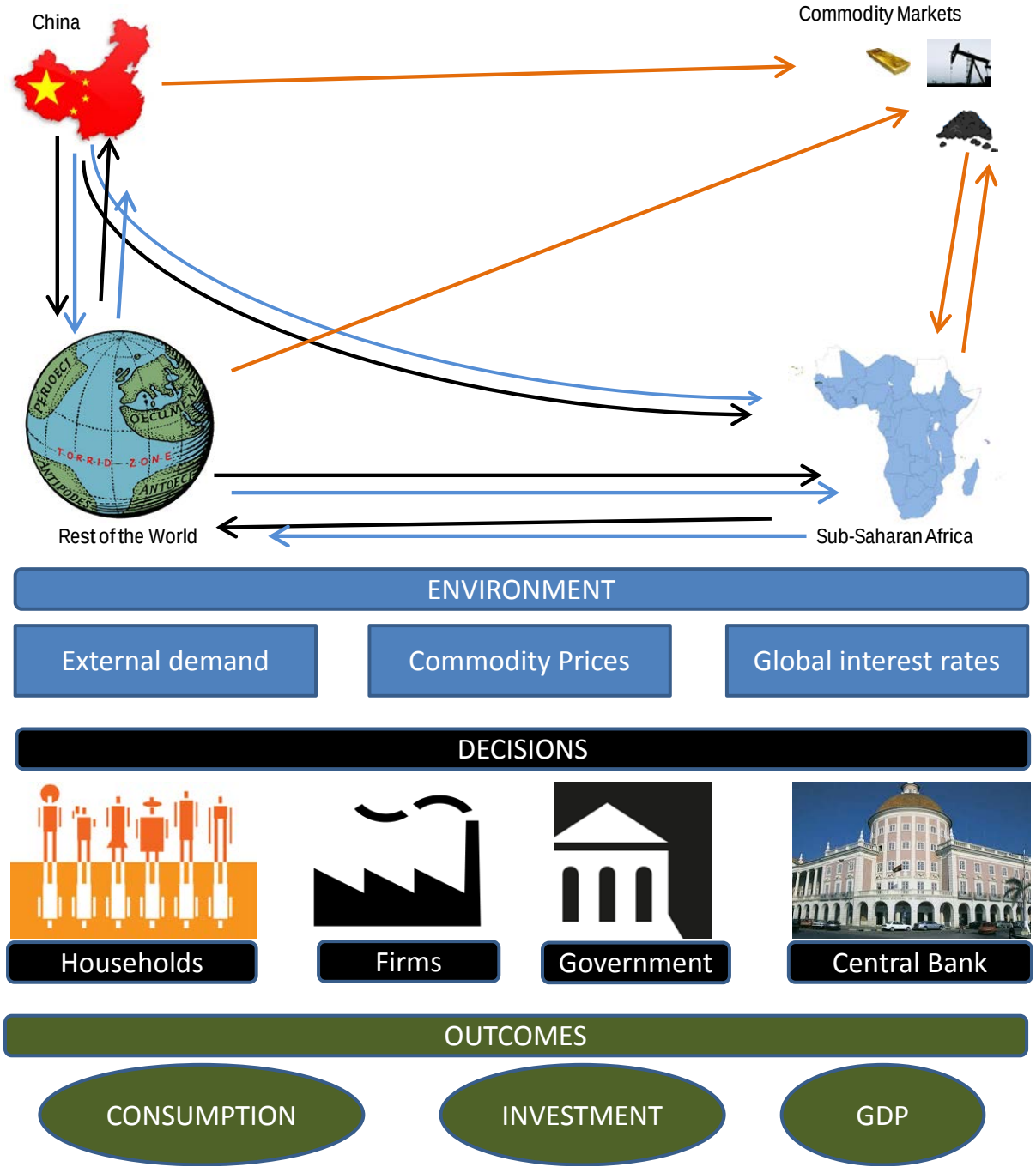
AFRMOD has 11 regions focused on sub-Saharan Africa, and a further 13 regions focused on their main trading partners and the rest of the world, for a total of 24 economies as in the other FSGM modules. The 11 regions include five countries: Angola (AGO), Ghana (GHA), Nigeria (NGA), South Africa (ZAF) and Zambia (ZMB), accounting for 72 percent of the region's GDP at constant PPP; and 6 regions – Eastern Africa (EAF), Fragile Africa (FAF), Low Income Africa (LIA), Middle Income Africa (MIA), other sub-Saharan Africa oil exporters (SSX) and other members of the West African Economic and Monetary Union (WMU). For our analysis, these are divided into two groups – commodity exporters (AGO, GHA, NGA, ZAF, ZMB and SSX) and commodity importers (the rest of sub-Saharan Africa). Among their trading partners are: advanced economies including some euro area members, Japan, the United Kingdom and the United States; separately-specified emerging economies including China and India; and other oil exporters.

The model comprises tradable goods only, and does not directly account for nontradable goods, like GIMF and GEM. It tracks the stocks such as human wealth, government debt, net foreign assets and capital that result from decisions in the model based on labor income, the deficit, trade and investment, for full stock-flow consistency with rational expectations.

The large number of economies and regions allows for flexibility in the study of spillovers. In each economy, external developments affect domestic activity through real channels and

financial channels that can be activated using correlated shocks. On the real side, the transmission takes place through export revenue and commodity prices. Export volumes matter for real economic activity and real GDP (and aggregate demand) is determined by the real national expenditure accounts identity.

Figure 5. Stylized Relations in a Internally Consistent Framework for Analyzing Spillovers from China onto Sub-Saharan Africa



Demand and Supply

Private consumption and investment are determined by structural equations with micro-foundations in which the evolution of government debt affects private domestic demand, even in the long term. In particular, consumption is modeled with a discrete-time representation of the Blanchard-Weil-Yaari overlapping generations model (OLG). Using the OLG framework introduces important non-Ricardian properties. . Essentially, households treat government bonds as wealth because there is a chance that the associated tax liabilities will fall due beyond their expected lifetimes. The OLG framework leads to the endogenous determination of global real interest rate, based on national savings given public debt. Investment is a standard Tobin's Q model.

Aggregate supply depends on the availability of human and physical capital at a given level of technology that varies over time. In particular, output is determined by a Cobb-Douglas production function in capital and labor, scaled by total factor productivity, which partly depends negatively on oil prices.

The interaction of aggregate demand and aggregate supply pins down core consumer price inflation, through a reduced-form Phillips' curve. Core inflation is a function of lagged inflation, expected future inflation, the output gap, and the real effective exchange rate to capture the effect of foreign prices, especially when countries import consumer goods heavily from abroad. Monetary policy and fiscal policy are endogenous – pinned down with simple rules.

Commodity Markets

The model allows the study of shocks to the supply or demand of commoditiesand their global impacts. In particular, the model includes trade in three commodities–oil, metals and food–and non-commodity goods and services. Exports and imports are modeled as reduced-form error correction equations. Exports of non-commodity goods and services increase with the effect of activity of trading partners on their import demand (where the size of bilateral trade linkages are important), and are also a decreasing function of a relative price variable, the real competitiveness index (RCI), defined as the ratio of their export prices of non-commodity goods and services to the equivalent foreign prices, using a multilateral weighting scheme based on fixed export shares that account for competition effects in from other countries. Imports of non-commodity goods and services increase with domestic demand, the cyclical position of the economy (measured by the output gap) and import prices. In turn, these import prices are related to foreign export prices expressed in domestic currency, using a multilateral weighting scheme based on fixed import shares.. The exchange rate effects found in the import price is also well measured by by the real effective exchange rate (REER). Commodity exports are modelled similarly, but respond to real global commodity prices of oil, metals or food, rather than the RCI or REER. The fixed export and import shares drive the trade spillover results, as found in Table 1.

The model assumes the global supply of commodities adjusts very sluggishly in the short-run but reacts to price movements in the medium-term if their real global prices deviate

persistently from their expected long-run value. In turn, the global demand for commodities depends on the overall level of activity in the world, and real global commodity prices are allowed to vary with conditions that affect the global economy. In particular, the real global prices of commodities depend on global supplies of commodities and global real GDP as a proxy of global demand.

For commodity exporting countries, the main impact on economic activity of developments in the market for commodities is transmitted through the terms of trade. Because the short-run supply of commodities is relatively fixed, export volumes do not have a significant direct impact on real GDP in the short term following an increase in commodity prices. This implies that export volumes of countries whose exports are dominated by commodities react less to global conditions than countries whose exports depend more on other products, including manufacturing.

An increase in the real global price of oil (and metals) increases consumption, investment and trend total factor productivity (TFP) in oil (and metals) net exporters and decreases them in oil (and metals) net importers. This is mostly explained by the wealth effect from the shift in the terms of trade. Higher commodity prices increase firms' costs and act as a negative productivity shock. They also lead to higher domestic food and oil prices that feed into headlineCPI inflation, and indirectly into core CPI inflation via higher costs of production for firms using oil and food.
For Angola, Nigeria and SSX, firms in the oil sector can be foreign-owned, sending profits abroad. Also, governments collect oil royalties and can subsidize oil use by households in firms.

Financial Channels

Transmission through financial channels take place through risk-adjusted uncovered interest rate parity (UIP), where the risk-free domestic return on assets must be equal to that of foreign assets (in this case with incomplete markets, a U.S. dollar-denominated bond), adjusted for exchange rate risk. However, there can be country-specific risk premia – onsovereign risk on all interest rates, domestic private risk on interest rates for households and firms, and corporate risk on the corporate interest rate.There is also a term premium between the 1-year and 10-year interest rates.

AFRMOD does not include other financial channels that have been considered in the academic literature and which could amplify the transmission of shocks from China onto sub-Saharan Africa. In particular, it does not include financial panics, herd behavior, strategic risk taking under bounded rationality, or deviations from rational expectations. Our framework does not attempt to study the effects of changes in financial sources, such as those that could arise from changes in the sources of funding or other types of portfolio adjustment. Furthermore, because the model assumes homogeneous expectations consistent with model assumptions and perfect foresight, it rules out dynamics associated to information asymmetries, unless such asymmetries are specifically assumed when simulating the model.

Monetary and Fiscal Policy

Fiscal and monetary policy matter for each region. The path for government debt matters because the overlapping generations households (who only have a planning horizon of 20 years) treat government bonds used to fund government spending as wealth. As a result, the associated uncertain future tax liabilities could fall due beyond their expected planning horizons. This implies that national saving depends on the level of government debt and the world real interest rate adjusts to equilibrate the global supply of and demand for saving. Also, the presence of liquidity-constrained households with no access to financial markets, who need to consume all their income each period, amplifies the effect of fiscal policy on the economy in the short term. Distortionary taxes further contribute to the impact of fiscal policy on the economy. Monetary policy is effective in the short term since it uses the 1-year interest rate as its policy instrument, which has an impact on the output gap, a key driver of both the short-term CPI inflation and wage Phillips' curves.

The transmission of shocks from China to sub-Saharan Africa depend on the policy reaction functions that are present not only in SSA but elsewhere in the world, especially in the largest economic blocs, including the United States, the euro area, and Japan. The parameterizations of the monetary and fiscal policy reaction functions are presented in Table 2.

The fiscal policy reaction function is designed to ensure a stable government debt-to-GDP ratio in the medium term by adjusting fiscal instruments (government spending, transfers, taxes and/or subsidies) so that the government deficit-to-GDP ratio remains stable. The base case reaction functions for all SSA countries assume that spending on general lump-sum transfers adjust to ensure that the public debt-to-GDP ratio is maintained in the medium term.

The monetary policy reaction functions vary across sub-Saharan countries depending on their exchange rate regimes. For countries with flexible exchange rates, we treat them as inflation targeters. Their reaction functions areforward looking and respond to deviations of inflation forecasts from their inflation target and to the output gap. Parameters are assumed to be the same for the rest of the world, and SSA countries such as Angola, Ghana, Nigeria and South Africa. There can also be a small weight on the nominal exchange rate relative to the U.S. dollar or the euro in order to replicating managed floating regimes (for regions like FAF, LIA, and MIA). For countries (such as WMU) that target a fixed nominal exchange rate against the euro, they are obligated to import euro area interest rates responses in order to defend their peg.

VI. Spillovers to Sub-Saharan Africa from Lower Potential Output in China (Initially perceived as a cyclical slowdown)

Global growth has declined after the global financial crisis. In China, five-year ahead growth forecasts prepared by IMF staff have declined to about 6 percent in 2015 from about 10 percent in 2008 (Figure 6). How much of this decline reflects cyclical behavior and how much a decline in potential output over time is an open question that will become clear in the future. It is now widely accepted, however, that some of the decline definitely reflects a decline in potential output, but there is ample debate about the magnitude.The situation is

explained graphically in Figure 7, which distinguishes between a cyclical slowdown and a permanent decline in potential output.

The scenario in this section assumes a lower-than-expected potential output in China, initially misperceived as a cyclical slowdown driven by lower investment. Over time, agents realize that downward growth revisions actually reflect a permanent decline in the level of trend TFP which negatively affects the level of potential output. Specifically, China experiences 4 consecutive years of lower growth for a permanent cumulative loss of 12 percent on the level of real GDP after 4 years, compared to the baseline scenario.

The baseline and the magnitude of the deviations from such baseline expressed in this scenario are purely illustrative and do not represent the views of IMF staff in general, about the magnitude of the decline of potential output in China with respect to the one that was expected before the crisis. Rather the exercise attempts to highlight the channels of transmission to sub-Saharan Africa that would be activated by a lower level of potential output in China that initially was expected to be only temporarily lower. This hypothetical scenario also of course differs from the slowdown observed in China after the global financial crisis in that it focuses only on developments in China abstracting from real and financial sector developments elsewhere and in assuming with certainty a specific reduction in potential output.

Figure 6. China GDP growth
Percent, Several WEO vintages.

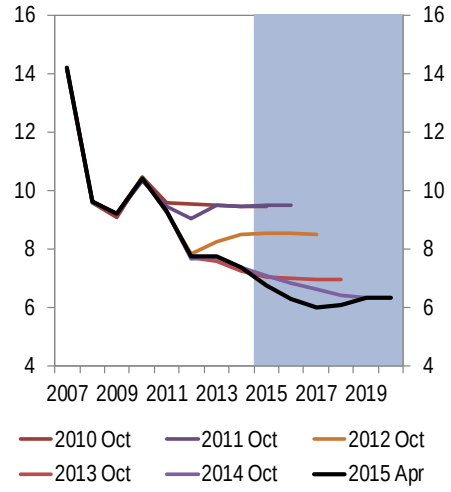
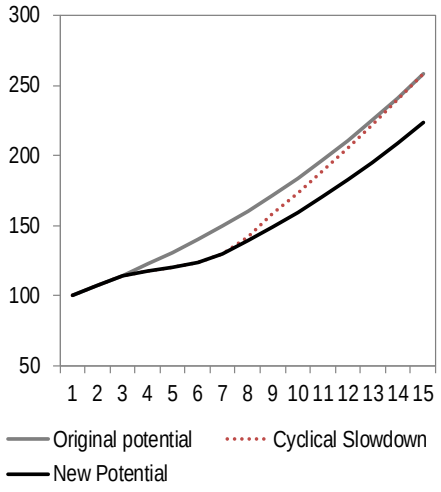


Figure 7. Lower Potential Vs. Cyclical Slowdwon
Indices



Source: IMF, *World Economic Outlook Database*

To understand the impact of these developments on sub-Saharan Africa, it is useful to describe how they affect China itself and the spillovers to other advanced economies. What is not understood by households and firms in China is that the lower investment is actually the result of the downward shifts in the marginal productivity of capital and labor schedules from a permanent decrease in trend TFP. With the perception of only temporarily lower investment, China ends up with lower output and income. Since the decline in income is perceived as temporary, there is lower private saving, and households strive to smooth the

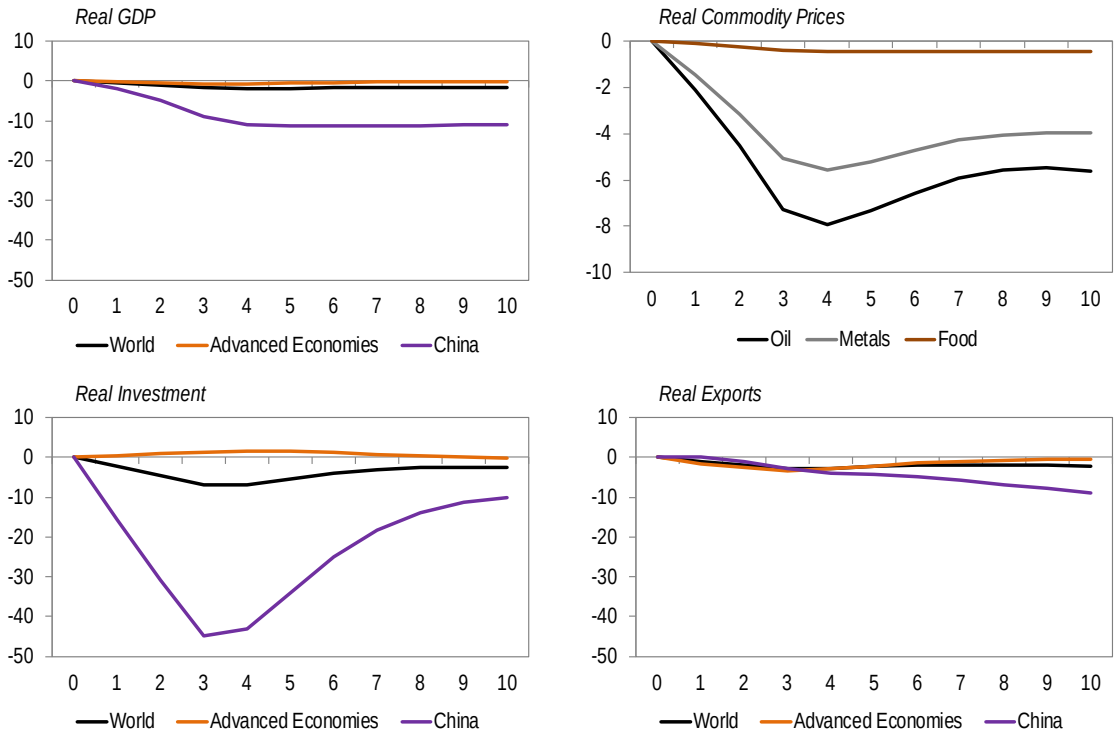
shock over time by borrowing against relatively higher future income. The effect on real interest rates is in principle uncertain, but the lower private saving tends to boost the impact of the lower productivity on investment. Lower real interest rates tend to dominate, however, if the effect of the lower productivity of capital exceeds that of higher private saving. Although the central bank cuts nominal interest rates in the short term, mitigating the fall in domestic demand compared to the counterfactual, it does not overturn lower demand.

As individuals realize that trend TFP is in fact permanently lower, domestic demand declines and private saving picks up from its low levels. The present value effect on income over time for households and firms is much larger than earlier expected. However, because the effect is permanent, there is less of a case for trying to smooth the effect over time by borrowing from future income. The lower returns to capital from lower productivity leads to lower investment, which leads to a lower capital stock, magnifying the negative effect on potential output. As firms understand that they are permanently less productive, they also shed labor. Both factors lead to permanent declines in income and wealth and lower consumption. The changing perceptions on the duration of lower real GDP could have effects on the real exchange rate dynamics of these countries. When firms and households expect the lower real GDP to be temporary, the monetary authorities perceive higher excess supply (a negative output gap, with potential exceeding the temporarily lower level of activity) and forecast falling inflation. In response they ease interest rates and via uncovered interest parity (UIP) the real exchange rate depreciates, stimulating foreign demand. However, when the shock is understood as permanent and coming from economy-wide trend TFP, the real exchange rate appreciates. Because of lower than expected trend TFP,China produces more expensive goods and services to sell to the rest of the world than expected in the past, and demands fewer imports given its lower income level. To maintain external balance the real exchange rate appreciates to raise the relative price of China's exports and thus reduce external demand. The appreciation also lowers the price of imports, helping to support China's demand for imports. The decline in exports is gradual, as short-run depreciation masks the negative productivity effect in the short term. Imports decline in line with domestic demand. Overall, there is a short-run improvement in the current account, driven by the more rapid decline in import volumes.

Lower growth in China has non-negligible effects on global real GDP, which permanently declines by more than 1.6 percent with respect to the baseline. For advanced economies, real GDP only declines marginally (reaching a trough at -0.7 percent and settling at about -0.2 percent relative to the baseline), but domestic demand in key emerging markets declines,

reducing the overall size of sub-Saharan African export markets (Figure 8). Because of the short-run problems in perceiving the extent of the change in China's real GDP, the short-run effects are more negative than they would have been otherwise, which will lead to larger negative spillovers.

Figure 8. Sub-Saharan Africa: World Developments in Lower Potential Output in China Scenario
Percent Deviations from Baseline



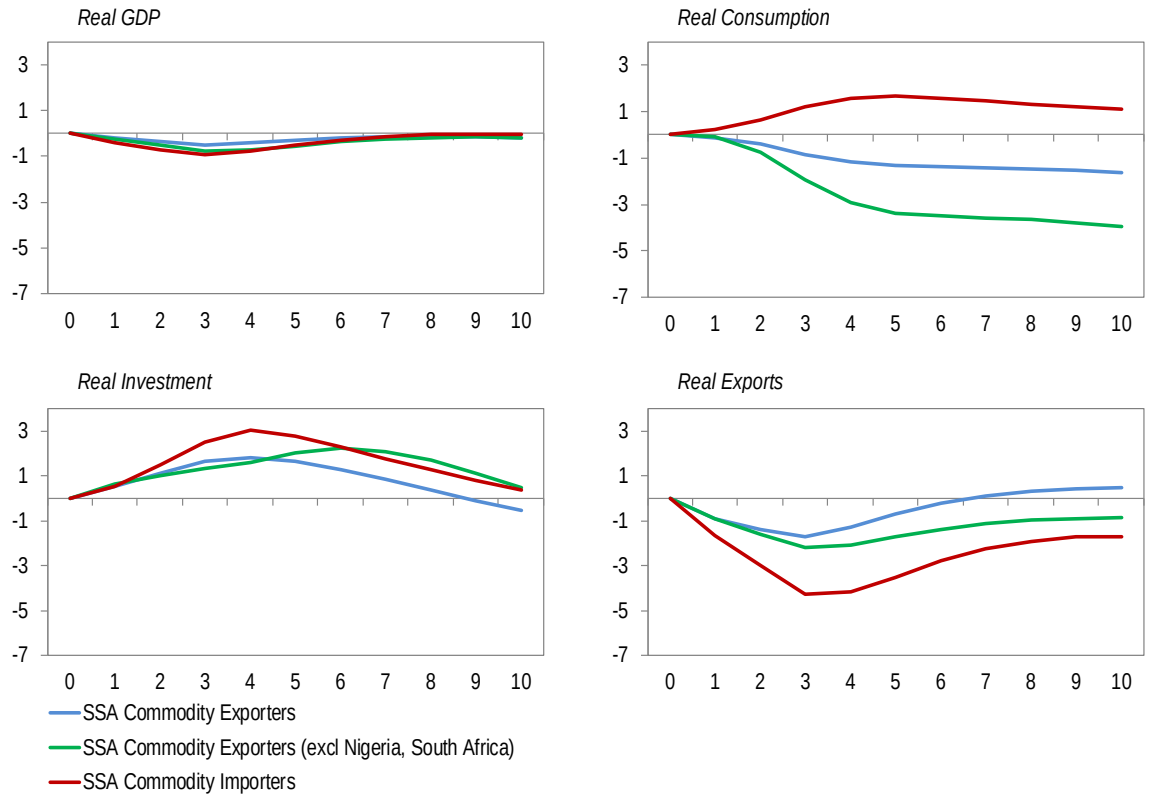
Source: Authors' simulations.

The global decline in real GDP leads to declines in commodity demand. Consequently, real global prices of oil, metals, and to a significantly lesser extent food, decline. This affects commodity exporters through terms-of-trade effects. In the simulation, the global real price of oil fall by close to 8 percent and then recover somewhat by the end of 10 years, remaining about 6 percent lower than in the baseline. The global real metals price follow a similar trend, remaining at about 4 percent lower by the end of ten years. The global real price of food fall much less, ending the period at about 0.5 percent lower than in the baseline.

The differences in the spillovers in sub-Saharan Africa depend on the size of their external sectors, their direct linkages with China, and the composition of the exports and imports of each economy, among other factors. Over all, the negative spillovers in SSA commodity importers are driven solely by its links with China. However, the outcomes in SSA commodity exporters are not uniquely defined by the fact that the shock emanates from China; a large part of the impact is indirect, coming through negative effects on global commodity markets.

Because the China's real GDP, and global real GDP in general, aggregate export demand decreases for both commodity exporters and commodity importers (Figure 9). The decline in the real exports of commodity exporters will be less pronounced than for commodity importers because of their lower elasticities of demand and supply of commodities. But commodity exporters are affected not only by the lower export volumes, they suffer the adverse income and wealth effects from lower real commodity prices. While consumers in both commodity exporting and commodity importers benefit from lower commodity prices, in commodity exporters the negative income effect prevails. As a consequence, consumption ends up being lower in commodity exporting countries, but larger in commodity importing countries. Private investment increases in both country groups encouraged by lower production costs and interest rates. These demand developments help offset some of the negative impact on real GDP of lower external demand. Admittedly, the increase in private investment in this scenario can be controversial, as it is an implication of Tobin's Q model investment used here. There is empirical evidence that investment tends to decline when commodity prices decline (Magud and Sosa, 2015). If that were to be the case, the adverse impact on real GDP would be even higher.

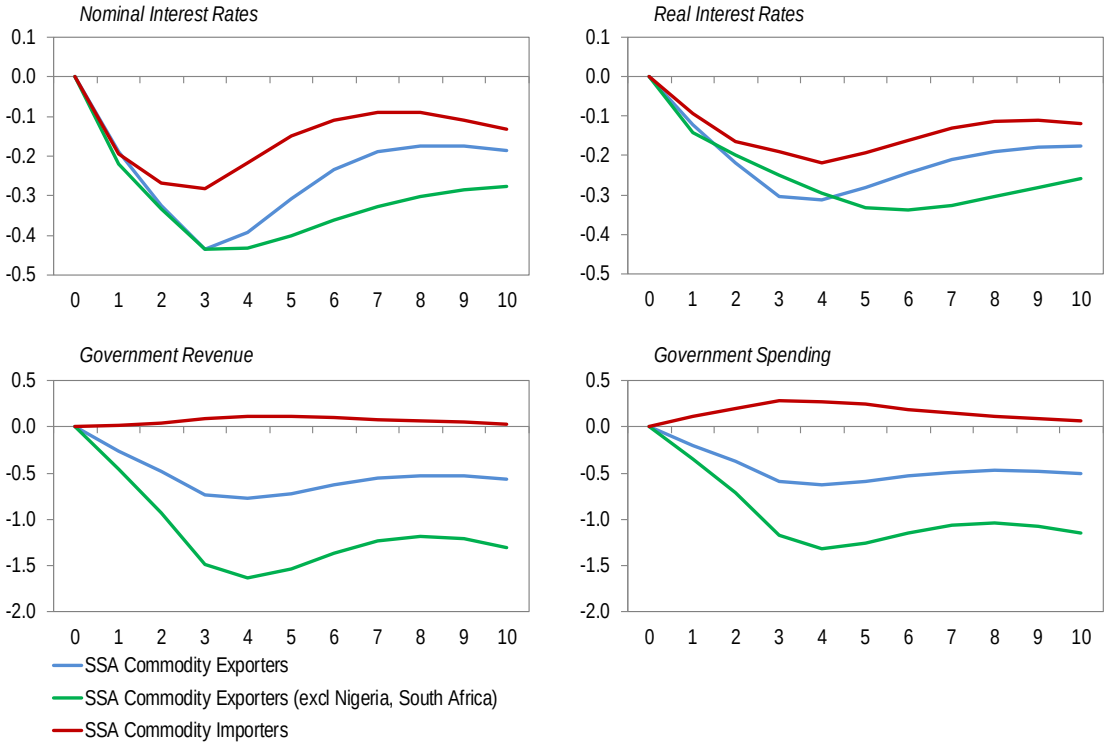
Figure 9. Sub-Saharan Africa: Macroeconomic Developments in Lower Potential Output in China Scenario
Percent Deviations from Baseline



Source: Authors' simulations.

Policy responses also help on the margin. Monetary policy contributes with slightly lower real interest rates for a sustained period of time (Figure 10). Fiscal spending in commodity exporters falls, but to a lesser extent and fiscal spending does not fully reflect the magnitude of the reductions in government revenue. In commodity importing countries, whose fiscal revenue increases slightly associated with its stronger domestic demand, the government is able to increase its spending.

Figure 10. Sub-Saharan Africa: Policy Responses in Lower Potential Output in China Scenario
Percent Deviations from Baseline



Source: Authors' simulations.

VII. Spillovers to Sub-Saharan Africa from Rebalancing Reforms in China

The observed decline in growth rates in China has prompted policy responses that strive to increase the level of potential output in the medium to longterm. As in the earlier scenario, the this scenario is solely illustrative and does not represent the IMF staff's views about the quantitative effects these reform may have on the Chinese economy or sub-Saharan Africa. They are intended to identify the channels of transmission and illustrate some factors that need to be considered when making actual forecasts.

For the simulations in this section we focus on the following four sets of reforms, based on Lam and Maliszewski (2015):

- Fiscal reforms equally phased in over 5 years. They consist of reducing government spending on unproductive infrastructure investment by about 3.0 percent of GDP, along with an increase in corporate income taxes. This allows for an increase in general

lumpsum transfers for education spending of 3.6 percent of GDP and in government consumption for healthcare spending of 2.0 percent of GDP. Furthermore, the corporate sector reforms are assumed to lead to a fall in their risk premium of 0.6 percentage points over 6 years.

- Structural reforms that lead to higher productivity. We assume these reforms increase the level of trend TFP by 1.5 percent by 2024, with a contribution of 1 percentage point from the nontradable sector and 0.5 from the tradable sector. Most of the returns materialize after 2020. The increases in trend TFP lead to an additional short-run increase in the labor participation rate, peaking at 0.25 percentage points by 2024, before returning to its normal path by 2028.

- Accelerated changes to government policy already found in the baseline scenario that reduces private saving sooner and encourage greater consumption now. We assume these reforms increase consumption by 8.2 percent by 2025, and eventually unwind relative to the baseline.

- A reduction in effective export subsidies by 3.0 percent of GDP over 6 years. This allows the government to decrease retail consumption taxes, allowing for an increase in domestic demand to offset some of the fall in external demand.

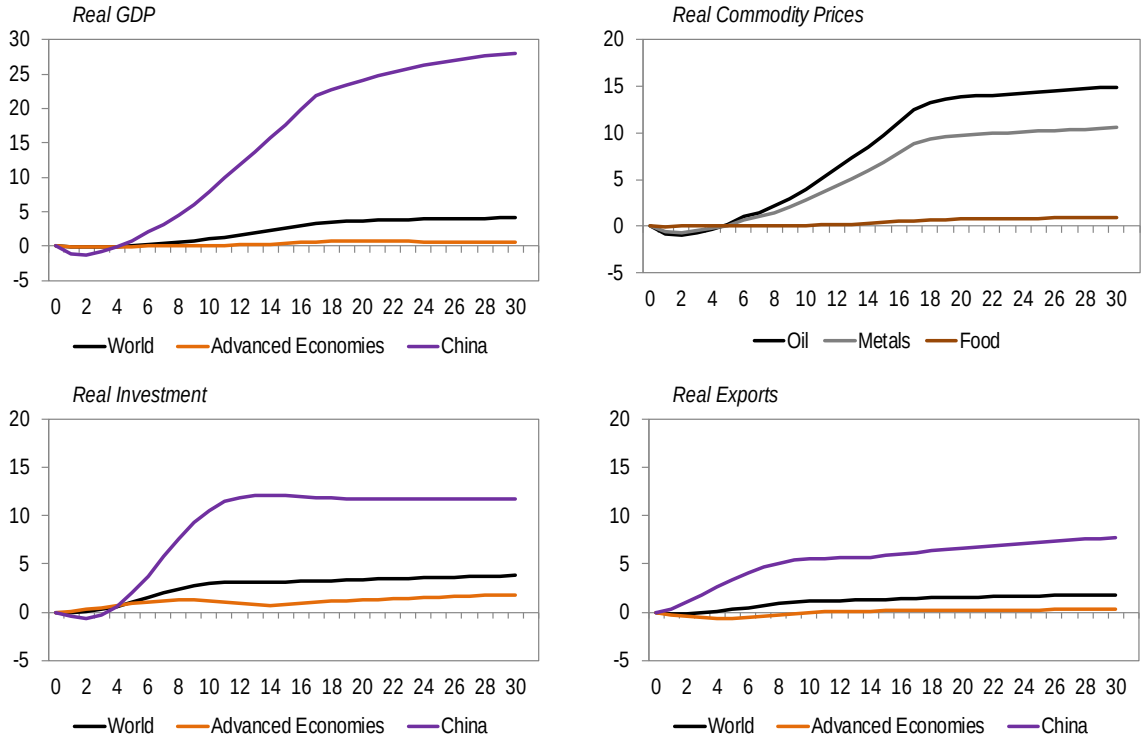
The scenario assumes that households and firms only gradually incorporate the full reform package in their decisions. Although they recognize that reforms carried out each year will have permanent effects, they do not factor in their decisions the reforms expected to unfold in future years. Because of this assumed "lack of credibility", the adjustment processes in the Chinese economy are slower than they would be otherwise, increasing the costs of transition, and delaying the impact of future expected benefits. For example, in the first year, firms observe a permanent 0.1 percent fall in the investment risk premium, but they do not formulate their investment plans on the additional 0.5 percent fall that is set to occur in the future. Therefore, investment gains are not as high as they could be, and labor demand does not shift as much, delaying gains in labor income and consequently consumption.

The combined effect of the reforms are minor for global real GDP in the first four years, but have an increasingly positive effect, being about 4 percent higher than baseline by year 15. The effect on the Chinese economy also varies over time. The immediate short-run costs drive down real GDP, but are more than offset in the long term. China's real GDP is smaller than the baseline in the first year, starts to recover by year 3, is about 8 percent greater than the baseline after 10 years, and is about 20 percent greater after 15 years. Private investment is below the baseline for the first five years, but starts to strengthen afterwards, as it is stimulated from the fall in investment risk, and also the demand for more capital to take advantage of the upswing in productivity.

Real global commodity prices drop very slightly on impact, as China suffers the start up costs of its reform process. But as time goes on, they increase as the Chinese economy expands, and puts upward pressure on demand for commodities as both consumption goods and

intermediate inputs for production. The real global food price moves the least in the long term, as it has the most elastic supply worldwide of the three commodity bundles (Figure 11).

Figure 11. Sub-Saharan Africa: World Developments in China Rebalancing Scenario
Percent Deviations from Baseline

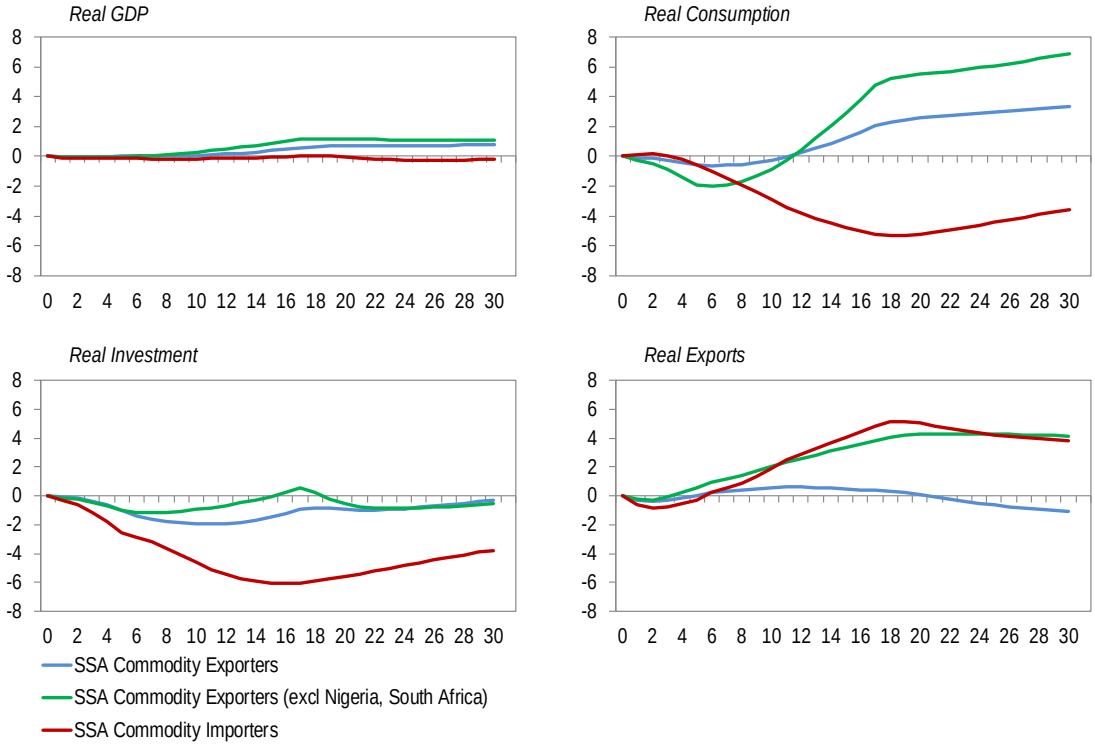


Source: Authors' simulations.

The impact on sub-Saharan Africa is heterogeneous and concentrated in the long term (Figure 12). Reflecting global developments that lead to an initial contraction and later expansion in global economic activity, for all sub-Saharan Africa, real exports fall on impact and then increase, more than offsetting the initial decline. The income and wealth effects from higher commodity prices lead to eventual increases in consumption in commodity exporting countries. In commodity importing countries, however, consumption and investment decrease, missing out on the benefits of higher global economic activity. First, the higher commodity prices increase production and fuel costs. Second, there is stronger competition from a more productive China for non-commodity exports in other markets. Overall, sub-Saharan Africa experiences higher levels of real GDP in the long term, led by the commodity exporting countries.

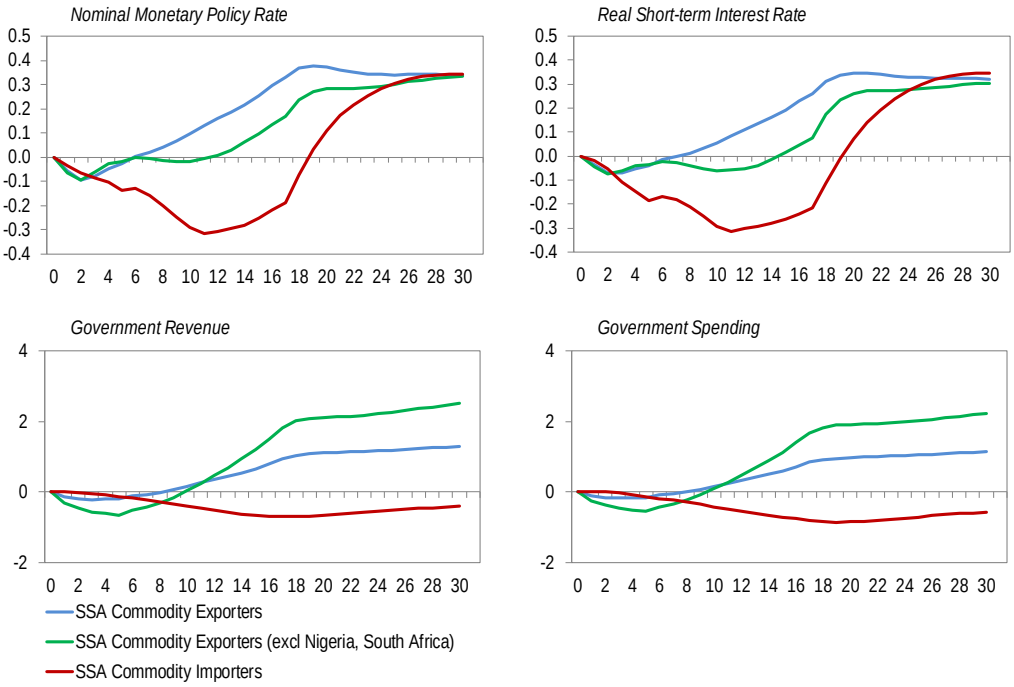
Monetary and fiscal policies try to smooth domestic demand. Interest rates initially fall and then increase for commodity exporters, whereas for commodity importers they continue to be low because of their weaker domestic demand. Fiscal policy in the sub-Saharan economies translates into spending a fraction of the impact triggered by the changes in the external environment (Figure 13).

Figure 12. Sub-Saharan Africa: Macroeconomic Developments in China Rebalancing Scenario
Percent Deviations from Baseline



Source: Authors' simulations.

Figure 13. Sub-Saharan Africa: Policy Responses in China Rebalancing Scenario
Percent Deviations from Baseline



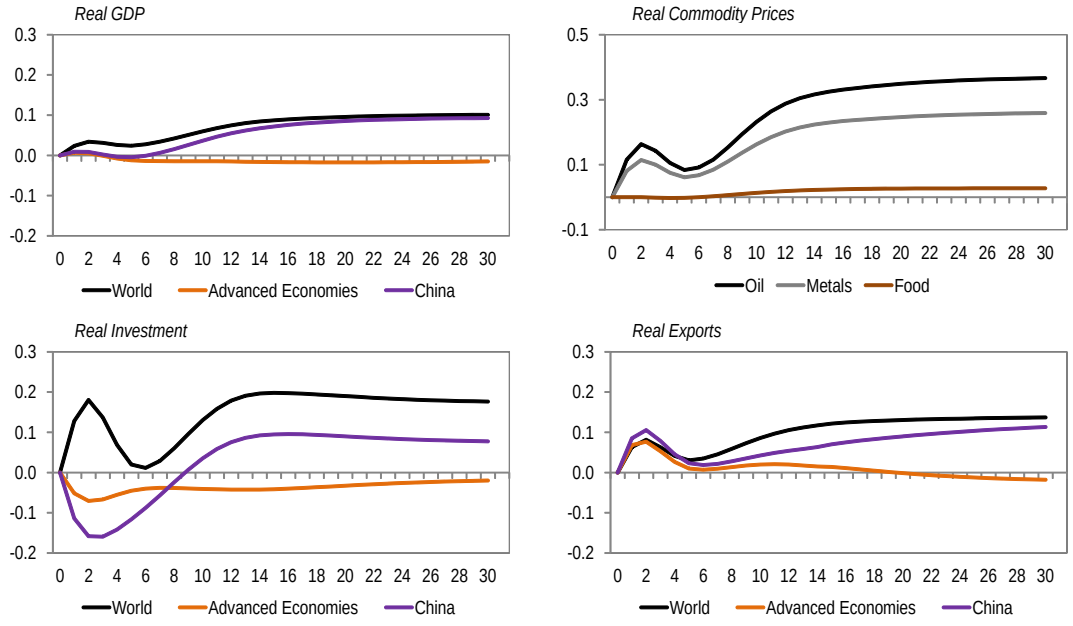
Source: Authors' simulations.

VIII. Spillovers from Relocation of Chinese Firms to Sub-Saharan Africa

The relocation of Chinese firms into sub-Saharan Africa is captured by increases in trend TFP in SSA countries and shifts in global trade shares from China to sub-Saharan Africa. The increase in trend TFP represents a relocation of about 2 percent of manufacturing exports from China into sub-Saharan Africa. For ease of exposition, the distribution of these exports within sub-Saharan Africa is made according to their initial real GDP weights so that trend TFP in all regions rise by roughly the same percentage of real GDP, and is focused in the export sector which produces manufactured goods and services. In practice, this simplifying assumption implies that the largest sub-Saharan African economies receive the bulk of the Chinese firms relocating into the region. It is likely that, in practice, Chinese firms would make their relocation decisions based on a variety of factors that include the business climate, country size, macroeconomic stability, and institutional development, among others.

Such a relocation from China increases real GDP in sub-Saharan Africa, but it only affects global real GDP by just over 0.1 percent with respect to baseline (Figure 14). The effect on China is also of about the same magnitude, increasing its real GDP by about 0.1 percent with respect to baseline, while the effect on advanced economies is negligible. The real effects take time to materialize given gestation lags and time to build human capital. The increase in global real GDP takes place because the relocation moves production activities from a place where productivity of labor is higher into a place where the productivity of labor is much lower but can increase significantly over time with transferred capital and technology, not only for the production of goods but for their worldwide distribution.

Figure 14. Sub-Saharan Africa: World Developments in China Relocation Scenario
Percent Deviations from Baseline



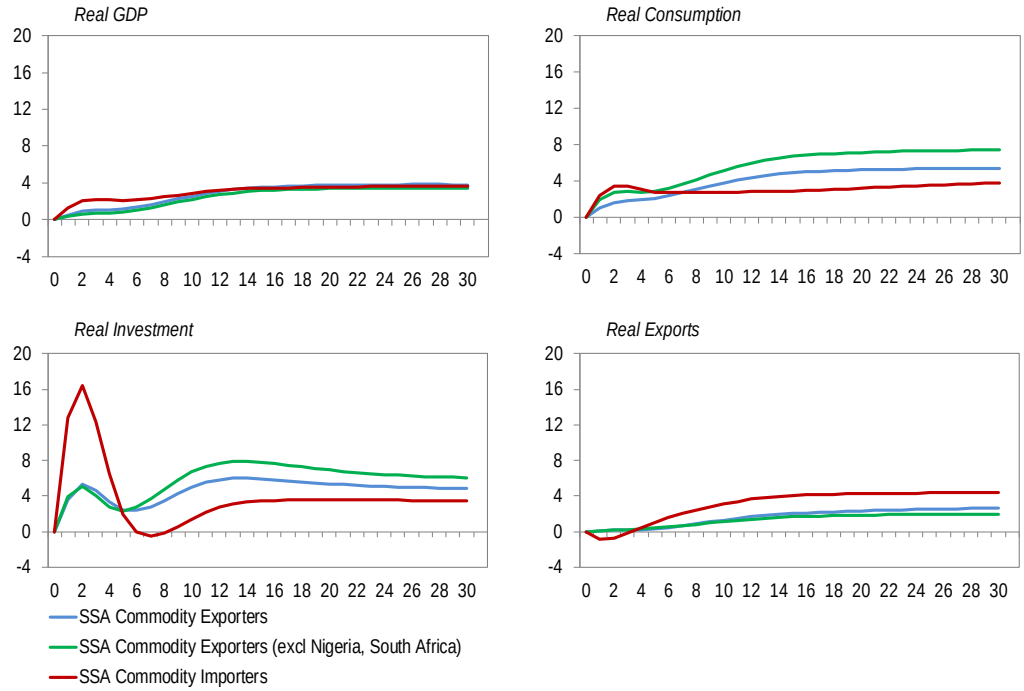
Source: Authors' simulations.

The real global prices of commodities are permanently albeit modestly larger in this scenario. They respond to increase global demand for items with a relatively low elasticity of supply. Real global oil prices end up being about 0.4 percent higher relative to the baseline, while real global metal prices increase only about 0.3 percent. The financial channels in the model play a limited role in this scenario, so real interest rates are virtually unchanged.

The impact on sub-Saharan Africa varies over time and across regions (Figure 15). Real GDP in sub-Saharan Africa expands by over 3 percent above baseline after 15 years. Real exports do not vary much over the first five years, but eventually pick up to about 2 percent of real GDP across the region. This is spread across the region relatively evenly. Relative to the baseline, real exports appear to increase less for commodity exporters than commodity importers, but this simply reflects that exports are a larger share of GDP to begin with for the commodity exporters.

The increase in exports of non-commodity goods and services in the long term is made possible in the short term by increased investment to build the necessary infrastructure for manufacturing. Relative to the baseline, the change in investment in commodity importers is much larger (over 15 percent at its peak in the second year) than in commodity exporters (around 5 percent in the second year). This reflects the weaker level of investment in the commodity importers, generally smaller economies (relative to commodity exporters such as Angola, Nigeria and South Africa) with very small economic bases. In the case of all SSA, most of the capital required is imported, so the current accounts worsen in the short term.

Figure 15. Sub-Saharan Africa: Macroeconomic Developments in China Relocation Scenario
Percent Deviations from Baseline



Source: Authors' simulations.

Nonetheless, the higher export demand leads to higher wealth and labor income in the economy, and stimulates domestic demand as well, further encouraging the increase in productive capacity for the provision of domestic goods. However, imports increase more than exports in the long term, as sub-Saharan Africa still has a strong preference for imported consumption goods.

Therefore, higher real GDP is broadly based in consumption, investment and exports, with stronger imports as well. Some of the short-run gains are mitigated because of monetary policy (Figure 16). Inflation is higher from increasing demand pressures, requiring higher interest rates in inflation-targeting regions (including those with managed floats) in the short term. Fixed exchange rate regimes face upward pressure on their real exchange rates in the short term, but downward in the long-run as higher productivity leads to economy-wide depreciations in SSA countries. Therefore, in the short term they experience higher inflation and lower real interest rates, further stimulating their economies, which is offset in the medium term with lower inflation and higher real interest rate.

Figure 16. Sub-Saharan Africa: Policy Responses in China Relocation Scenario
Percent Deviations from Baseline

Source: Authors' simulations.

IX. CONCLUSIONS

China has become a key global player and the main trading partner for many countries in sub-Saharan Africa and around the world. Its dynamic growth has pulled along many emerging and developing economies, whether directly through bilateral real and financial linkages, or indirectly, through the effect of Chinese growth on real global commodity prices, and to a certain extent lower interest rates. China has had a clearly beneficial impact on sub-Saharan Africa over the last decade and a half, not only through trade, but also as an increasingly important source of loans and foreign direct investment.

In this paper, we make the case that the magnitude and direction of the spillovers from China onto sub-Saharan Africa critically depend on the nature of the developments affecting China, the impact those may have on the global economy and key relative prices like global interest rates and real global commodity prices, the strength of bilateral real and financial linkages, the structure of the economy, and the policy responses from each of the affected economies.

Properly studying spillovers from specific developments in China requires a framework that factors in trade and financial linkages and reactions of individuals, firms, and fiscal and monetary authorities to changing external environments.

The scenarios in this paper study the effects on sub-Saharan Africa of three stylized situations in China, which can be used to capture a possible interpretation of recent developments and likely policy directions. The lower potential output scenario is a situation in which the Chinese output ends up being lower than initially expected and the expected strong recovery fails to materialize, much like developments after the global financial crisis. The China rebalancing scenario describes a situation in which China undertakes reforms with the objective of increasing its potential output, much like the 2013 Third Plenum reforms after many years in which real GDP growth, although high, failed to recover to the levels that were expected. Finally, the China relocation scenario is a situation in which some Chinese firms relocate to sub-Saharan Africa, building on the experience with pilot special economic zones in sub-Saharan Africa.

Our results suggest that, in general, the impact on sub-Saharan African economies vary depending on whether the economy is a commodity exporter or importer. The prevailing monetary policy regime can affect dynamics in the short term.

In the event of lower potential output in China, initially misperceived as cyclical slowdown and later recognized as permanent decline, global real GDP is 1.6 percent lower compared to baseline. Real commodity prices are also lower – oil prices by almost 8 percent. However, the net effect on economic activity on sub-Saharan Africa commodity importers is near zero because of the positive effect of lower global commodity. The overall impact on the commodity exporters is negative, about -0.5 percent of GDP.

The China rebalancing scenario has global effects that have an impact on sub-Saharan Africa. The simulations in this paper suggest that these reforms are likely to lead to higher real GDP of more than 25 percent in the medium to long term but at the expense of adverse effects on

Chinese economic activity in the short to medium term, with a decline of about 1 percent relative to baseline. During the transition, there is marginally negative impact on global economic activity and commodity prices are likely to be lower than in the baseline. But in the long term, oil prices are roughly 15 percent higher. Consequently, the Chinese reforms benefit the commodity exporters in sub-Saharan Africa by about 1 percent of real GDP, but they would provide little benefit to the commodity importers..

In the third scenario, all of sub-Saharan Africa experiences positive effects as countries in the region are able to build domestic industries based on China relocating a portion of its manufacturing base permanently to the region, with real GDP increasing relative to baseline around 4 percent. However, as the relocation process takes time, it takes about 10 years for the gains to be realized. We assume the distribution of gains are equivalent to their relative sizes in sub-Saharan Africa, although even if the relocation of manufacturing is focused on the smaller countries and regions, there would still be appreciable benefits for the region as a whole and, of course, relatively large gains for the smaller economies.

The scenarios describe forces that we assume will most likely be at play over the next few decades and that will partly determine developments in both China and sub-Saharan Africa. Although they only provide illustrative magnitudes for changes in real GDP and sub-Saharan Africa in general, they offer food for thought for those interested in understanding the interaction among these economies, particularly the importance of global commodity markets.

However, the illustrative figures should not be taken as a quantitative forecasts on developments in China or sub-Saharan Africa. Actual developments would be affected by developments elsewhere, differences in policy responses around the world from the ones assumed under the model and, among other things, financial frictions, balance-sheet exposures, and information assymetries that may greatly amplify the channels of transmission systematically we explore in this paper using the perfect foresight framework of AFRMOD. Our objective has been to use a internally consistent macroeconomic framework with micro-foundations that factors in bilateral trade relationships to study the spillovers from China to sub-Saharan Africa that puts us a step closer to a complex reality, and to highlight some of the key channels of transmission that would need to be considered in making a forecast, which lies beyond the scope of this paper.

Table 1. AFRMOD Fixed Trade Weights

Exports (Non-commodity Goods and Services)

Importer \ Exporter	USA	CHN	E.A.	AGO	GHA	NGA	ZAF	ZMB	EAF	FAF	LIA	MIA	SX9	WMU	ROW
USA	...	17.4	11.5	11.9	1.8	9.5	9.3	0.2	4.9	3.3	2.2	5.7	5.8	0.5	35.1
CHN	6.9	...	6.5	7.8	0.8	8.5	7.2	14.9	9.4	12.9	8.8	0.9	17.1	8.2	21.9
Euro area	13.6	14.3	...	26.5	3.4	29.5	16.1	4.8	20.4	17.1	39.5	15.6	21.8	5.2	39.0
AGO	0.1	0.1	0.3	...	0.0	0.0	0.9	0.1	0.4	0.1	0.1	3.0	0.0	0.0	0.2
GHA	0.1	0.2	0.1	0.6	...	0.7	0.5	0.0	0.1	1.4	0.0	0.1	0.6	1.2	0.2
NGA	0.2	0.5	0.3	3.3	1.4	...	0.9	0.0	0.0	0.9	0.0	0.4	4.2	1.5	0.8
ZAF	0.5	0.7	1.0	1.2	23.7	0.5	...	18.3	10.9	16.2	10.0	15.7	0.3	37.1	1.2
ZMB	0.0	0.0	0.0	0.0	0.0	0.0	2.6	...	1.5	6.2	0.5	0.8	0.0	0.0	0.0
EAF	0.1	0.2	0.1	0.1	0.0	0.0	1.9	3.3	...	0.3	0.9	0.5	0.3	0.0	0.5
FAF	0.1	0.5	0.3	0.5	45.0	1.0	3.9	24.3	6.2	...	3.5	3.9	1.3	6.1	0.4
LIA	0.1	0.1	0.1	0.9	0.0	0.0	3.2	5.2	3.0	0.6	...	2.0	0.0	0.0	0.3
MIA	0.0	0.1	0.2	0.6	0.1	0.0	9.6	2.2	0.8	0.9	1.1	...	0.8	2.2	0.2
SX9	0.1	0.1	0.3	0.1	0.1	0.9	0.2	0.0	0.2	0.3	0.0	0.6	...	0.1	0.2
WMU	0.1	0.2	0.1	0.0	0.9	0.6	0.2	0.0	0.1	2.1	0.2	2.3	0.0	...	0.1
ROW	78.2	65.5	79.0	46.7	22.6	48.8	43.6	26.5	42.0	37.6	33.0	48.4	47.7	37.8	...
Memorandum Items:															
Non-commodity exports(% Real GDP)	15.8	30.7	46.6	31.6	30.9	1.5	29.2	29.2	37.1	43.3	38.0	50.8	9.1	28.1	28.9
Share of Global GDP	21.6	16.2	13.6	0.2	0.1	1.0	0.3	0.1	0.2	0.2	0.2	0.1	0.1	0.1	52.4

Imports (Non-commodity Goods and Services)

Exporter \ Importer	USA	CHN	E.A.	AGO	GHA	NGA	ZAF	ZMB	EAF	FAF	LIA	MIA	SX9	WMU	ROW
USA	...	8.1	10.4	8.8	9.5	10.0	9.5	1.6	4.1	3.4	5.1	2.5	6.3	8.2	23.5
CHN	23.6	...	16.8	18.8	16.4	18.3	18.6	11.1	19.9	18.9	18.5	11.3	13.6	39.6	35.2
Euro area	15.5	13.3	...	36.5	20.0	22.4	27.1	5.7	14.6	13.2	14.8	17.5	44.8	18.7	38.8
AGO	0.0	0.0	0.0	...	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
GHA	0.0	0.0	0.0	0.0	...	0.8	0.0	0.0	0.1	0.8	0.0	0.1	0.1	1.3	0.1
NGA	0.0	0.1	0.3	0.0	0.4	...	0.0	0.0	0.0	0.2	0.0	0.0	1.4	1.1	0.2
ZAF	0.5	1.9	0.9	5.4	3.1	2.0	...	38.0	8.9	14.1	16.1	40.3	1.9	2.2	1.4
ZMB	0.0	0.1	0.0	0.0	0.0	0.0	0.3	...	0.4	1.6	0.8	0.6	0.0	0.0	0.1
EAF	0.0	0.0	0.1	0.2	0.1	0.0	0.1	1.9	...	1.2	1.3	0.3	0.1	0.0	0.1
FAF	0.0	0.2	0.2	0.1	1.7	0.2	0.6	19.3	0.2	...	0.4	0.9	0.4	4.0	0.2
LIA	0.0	0.1	0.1	0.0	0.0	0.0	0.9	0.5	0.4	0.5	...	0.4	0.0	0.0	0.1
MIA	0.1	0.0	0.1	3.2	0.3	0.1	0.5	1.3	0.4	2.0	2.0	...	0.7	3.4	0.1
SX9	0.0	0.1	0.1	0.0	0.3	0.6	0.0	0.0	0.1	0.2	0.0	0.3	...	0.0	0.1
WMU	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.0	...	0.1
ROW	60.2	75.9	70.9	26.9	48.0	45.2	42.5	20.6	50.9	43.6	40.8	25.8	30.5	21.4	...
Memorandum Items:															
Non-commodity imports(% Real GDP)	13.7	25.3	43.9	52.1	37.8	11.9	26.6	54.4	29.4	40.4	29.2	46.2	27.6	11.4	35.3
Share of Global GDP	21.6	16.2	13.6	0.2	0.1	1.0	0.3	0.1	0.2	0.2	0.2	0.1	0.1	0.1	52.4

Source: Authors' calculations based on 2011 data (except for memorandum items: AFRMOD steady state).
Euro area comprises: FRA, DEU, ITA, and, EA9; ROW comprises the rest of the world outside of the regions mentioned.

Table 1. AFRMOD Fixed Trade Weights (cont'd)

Exports (Oil)

Importer \ Exporter	USA	CHN	E.A.	AGO	GHA	NGA	ZAF	ZMB	EAF	FAF	LIA	MIA	SX9	WMU	ROW
USA	...	4.1	14.4	23.5	0.4	25.0	0.0	0.0	0.0	22.5	0.0	0.0	35.3	0.0	40.5
CHN	1.1	...	1.6	42.6	3.7	0.7	0.0	0.0	0.0	7.5	0.0	0.0	20.5	0.0	13.7
Euro area	17.1	6.1	...	14.0	84.8	20.6	0.0	0.0	0.0	18.9	0.0	0.0	25.8	0.0	41.0
AGO	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GHA	0.2	0.0	0.7	0.0	...	0.7	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.1
NGA	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ZAF	0.4	0.2	0.4	2.7	0.0	3.0	...	0.0	0.0	1.0	0.0	0.0	0.0	0.0	1.4
ZMB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.1
EAF	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	...	0.1	0.0	0.0	0.0	0.0	0.8
FAF	0.2	2.6	1.1	0.0	0.0	1.9	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.4
LIA	0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.5	...	0.0	0.0	0.0	0.4
MIA	0.0	0.0	0.9	0.0	0.0	0.4	0.0	0.0	0.0	0.3	0.0	...	0.0	0.0	1.2
SX9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0
WMU	0.0	0.0	1.2	0.0	0.0	0.1	0.0	0.0	0.0	3.2	0.0	0.0	0.0	...	0.6
ROW	80.8	87.0	79.5	17.2	11.1	47.6	0.0	0.0	0.0	43.7	0.0	0.0	18.2	0.0	...
Memorandum Items:															
Oil exports(% Real GDP)	0.5	0.3	2.6	26.5	5.7	13.5	0.0	0.0	0.0	3.8	0.0	0.0	24.8	0.0	8.6
Share of Global GDP	21.6	16.2	13.6	0.2	0.0	1.0	0.3	0.0	0.2	0.2	0.2	0.1	0.1	0.1	52.4

Imports (Oil)

Exporter \ Importer	USA	CHN	E.A.	AGO	GHA	NGA	ZAF	ZMB	EAF	FAF	LIA	MIA	SX9	WMU	ROW
USA	...	0.5	3.0	0.0	0.6	0.0	2.4	0.0	0.1	2.2	0.8	1.7	0.0	0.8	38.9
CHN	0.1	...	0.0	0.0	6.9	0.0	0.3	0.1	0.1	10.5	0.1	0.0	0.0	0.0	4.6
Euro area	2.8	0.7	...	0.0	27.5	0.0	1.6	0.1	1.5	13.4	0.2	12.4	0.0	27.1	19.8
AGO	3.1	10.3	1.8	...	0.0	0.0	7.7	0.0	0.0	0.2	0.0	0.0	0.0	0.0	4.5
GHA	0.1	0.0	0.5	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	0.1
NGA	7.8	0.3	4.8	0.0	0.2	...	15.2	0.0	0.0	30.8	0.0	12.3	0.0	1.9	29.9
ZAF	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ZMB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EAF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0
FAF	0.2	0.1	0.2	0.0	7.9	0.0	0.2	0.1	0.1	...	1.9	0.9	0.0	5.9	0.3
LIA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0
MIA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0
SX9	2.6	2.7	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	...	0.2	1.7
WMU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0
ROW	83.4	85.2	87.7	0.0	56.9	0.0	72.7	99.7	98.2	42.6	97.0	72.7	0.0	62.0	...
Memorandum Items:															
Oil imports(% Real GDP)	2.3	3.3	3.5	0.0	0.3	0.0	4.9	2.7	6.0	6.1	6.3	6.3	0.0	14.3	3.2
Share of Global GDP	21.6	16.2	13.6	0.2	0.1	1.0	0.3	0.1	0.2	0.2	0.2	0.1	0.1	0.1	52.4

Source: Authors' calculations based on 2011 data (except for memorandum items: AFRMOD steady state).
Euro area comprises: FRA, DEU, ITA, and, EA9 from AFRMOD, the entire euro area; ROW comprises the rest of the world outside of the regions mentioned.

Table 1. AFRMOD Fixed Trade Weights (concluded)

Exports (Metals)

Importer \ Exporter	USA	CHN	E.A.	AGO	GHA	NGA	ZAF	ZMB	EAF	FAF	LIA	MIA	SX9	WMU	ROW
USA	...	0.0	10.1	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	26.8	0.0	15.8	8.1
CHN	9.2	...	18.0	0.0	0.0	0.0	56.9	15.8	0.0	0.0	0.0	4.9	0.0	0.9	58.0
Euro area	8.8	0.0	...	0.0	0.0	0.0	11.9	4.7	0.0	0.0	74.1	32.1	0.0	66.6	33.3
AGO	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GHA	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NGA	0.0	0.0	0.4	0.0	0.0	...	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
ZAF	0.0	0.0	0.1	0.0	0.0	0.0	...	4.4	0.0	0.0	0.0	0.0	0.0	0.0	0.2
ZMB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.2
EAF	0.0	0.0	0.1	0.0	0.0	0.0	0.3	0.4	...	0.0	0.0	0.0	0.0	0.0	0.1
FAF	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0
LIA	0.0	0.0	11.1	0.0	0.0	0.0	0.0	0.7	0.0	0.0	...	0.0	0.0	0.0	0.0
MIA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0
SX9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0
WMU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0
ROW	82.0	0.0	60.3	0.0	0.0	0.0	29.7	74.0	0.0	0.0	25.9	36.2	0.0	16.7	...
Memorandum Items:															
Metals exports(% Real GDP)	0.0	0.0	0.3	0.0	0.0	0.0	3.1	27.8	0.0	0.0	4.0	1.8	0.0	3.2	1.1
Share of Global GDP	21.6	16.2	13.6	0.2	0.0	1.0	0.3	0.0	0.2	0.2	0.2	0.1	0.1	0.1	52.4

Imports (Metals)

Exporter \ Importer	USA	CHN	E.A.	AGO	GHA	NGA	ZAF	ZMB	EAF	FAF	LIA	MIA	SX9	WMU	ROW
USA	...	0.3	0.8	0.0	0.0	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.6
CHN	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Euro area	2.5	0.7	...	0.0	0.0	17.7	0.8	1.3	3.1	1.9	88.2	0.0	0.0	0.0	22.7
AGO	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GHA	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NGA	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ZAF	0.4	4.6	1.4	0.0	0.0	16.1	...	2.5	34.2	51.0	0.1	0.0	0.0	0.0	19.5
ZMB	0.0	0.8	0.6	0.0	0.0	0.0	32.0	...	0.3	19.9	7.6	0.0	0.0	0.0	37.4
EAF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0
FAF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0
LIA	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	2.6
MIA	1.6	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	2.8
SX9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0
WMU	0.5	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.4
ROW	95.0	93.6	93.9	0.0	0.0	63.2	67.2	96.2	62.5	27.1	4.1	0.0	0.0	0.0	...
Memorandum Items:															
Metals imports(% Real GDP)	0.1	2.3	0.5	0.0	0.0	0.0	0.1	1.2	0.1	0.0	1.3	0.0	0.0	0.0	0.4
Share of Global GDP	21.6	16.2	13.6	0.2	0.0	1.0	0.3	0.0	0.2	0.2	0.2	0.1	0.1	0.1	52.4

Source: Authors' calculations based on 2011 data (except for memorandum items: AFRMOD steady state).
Euro area comprises: FRA, DEU, ITA, and, EA9 from AFRMOD, the entire euro area; ROW comprises the rest of the world outside of the regions mentioned.

Table 2. Monetary Policy Regimes in AFRMOD

	Advanced Economies	African Floating 1/	African Managed Float 2/	WAEMU (WMU) 3/	China	Other Emerging Markets
Lagged interest rate	0.30	0.30	0.30	1.00	0.30	0.30
Weight on inflation gap	1.50	1.50	1.50	0.00	1.50	1.50
Mix of inflation at *t* and *t+1*	0.25	0.25	0.25	0.00	0.25	0.25
Weight on output gap	0.34	0.34	0.34	0.00	0.34	0.34
Weight on nominal exch. rate against the euro	0.00	0.00	Between 0.30-1.25	100000	0.00	0.00

Source: Authors' calculations

1/ Includes AGO, GHA, NGA, ZAF, ZMB, and EAF.

2/ Includes FAF (with a weight of 0.75 on the euro rate); SSX(weight of 1.25); LIA and MIA (weight of 0.30).

3/ Parameterization ensures a fixed nominal exchange rate against the euro.

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