Global Trade Analysis Project
https://www.gtap.agecon.purdue.edu/

This paper is from the
GTAP Annual Conference on Global Economic Analysis
https://www.gtap.agecon.purdue.edu/events/conferences/default.asp

Stress-testing Africa's recent growth and poverty performance[1]

Shantayanan Devarajan
Delfin S. Go
Maryla Maliszewska
Israel Osorio-Rodarte
Hans Timmer

June 9, 2013

Abstract

After an impressive acceleration in growth and poverty reduction since the mid-1990s, many African countries continue to register robust growth in the aftermath of the global financial crisis. Will this growth persist, given the tepid recovery in developed countries, numerous weather shocks and civil conflicts in Africa? This paper "stress tests" African economies. Our findings indicate that Africa's long-term growth is fairly impervious to a prolonged recession in high-income countries. Growth is, however, much more sensitive to a disruption of capital flows to the region, and to internal shocks, such as civil conflict and drought, even if the latter follow historical patterns. The broad policy implication is that with proper domestic production conditions African countries can sustain robust long-term growth. Because of the economic dominance of the agriculture sector and the share of food in household budgets, countries will need to increase the resilience of agriculture and protect it from unfavorable climate change impacts, such as drought. As in the past, civil conflicts and violence will pose by far the greatest threat to Africa's performance.

[1] The views expressed are those of the authors and do not necessarily reflect those of the World Bank or its affiliated organizations. The authors would like to thank Allen Dennis….for helpful comments and suggestions.

Introduction

Despite the recent global economic recession, most countries in Sub-Saharan Africa (hereafter SSA or Africa) have continued to register relatively robust growth. In fact, since the mid-1990s an acceleration of economic growth in much of Africa has produced rising incomes and faster human development. These achievements were not just due to a favorable external environment – such as expanding global trade, buoyant export prices, debt relief and rising foreign aid for much of the period – but also to an improved policy environment, including greater macroeconomic stability and market reforms that cut state interventions and their fiscal costs, as well as to lower frequency of civil conflicts in the region (Arbache et al 2008). Although challenges in policy and governance remain, growth has been pervasive across African countries, be they resource-rich or resource-poor, large or small, landlocked or coastal (World Bank 2013). This unprecedented performance naturally raises the question: If there are further adverse shocks to the global economy and the region, will growth persist in the long-term? This paper attempts to answer this question by "stress-testing" African economies using an integrated set of general-equilibrium models of the global economy that simulate the effects of shocks on national economies.

The empirical analysis in this paper relies on two tools developed at the Development Economic Prospects Group of the World Bank: the LINKAGE global CGE model and the Global Income Distribution Dynamics (GIDD) micro-simulation framework. We cover 18 individual SSA countries, along with the BRICS, the remaining developing countries, as well as the EU, the US, the OPEC and the remaining high income countries. Poverty and impact on the distribution of welfare among households and individuals are calculated from the GIDD, a global micro-simulation model. This global macro-micro model combines a set of price and volume changes from the CGE model with expected changes in demographic structure to create a simulated distribution of income in 2025.

The long-term scenarios consist of a baseline and a set of adverse shocks as alternatives through 2025. The baseline scenario tracks the historical growth from the base year 2007 to 2012 and follows the current medium and long-term global economic projections of the World Bank. The baseline describes a steady recovery from the recent economic recession in high-income countries and continued growth in developing countries. In this scenario, the share of developing countries and also of Africa in global GDP is gradually rising. Within Africa, Nigeria catches up to South Africa as the dominant economy. Next, we examine how this baseline economic performance is disrupted by a set of severe adverse shocks, both external and internal to the Africa region. In the spirit of stress testing, all these shocks are hypothetical; although possible, they are not meant to be understood as likely any time soon or in the selected countries applied. Shocks that originate outside of Africa include: prolonged recession in the high-income countries, prolonged recession coupled with a collapse of financial flows in and out of SSA, and an OPEC oil supply shock. Two shocks that originate in Africa include: drought in several countries, and civil conflict in key SSA countries. The paper examines the growth and poverty impact of these shocks on African economies.

The remainder of the paper is organized in the following sections: (i) methodology, (ii) baseline scenario, (iii) alternative scenarios, (iv) impact on poverty, and (v) conclusions.

Methodology

We design the forward-looking scenarios by employing the World Bank's LINKAGE and GIDD models. LINKAGE is a global general-equilibrium model with an adjustable number of countries, regions and production sectors, linked by global trade flows and finance (van der Mensbrugghe 2013). Its current database is the Global Trade Analysis Project (GTAP) 8 with 2007 as the base year.[2] At its core, LINKAGE is essentially a neo-classical growth model, with aggregate growth predicated on assumptions regarding the growth of the labor force, savings/investment decisions (and therefore capital accumulation) and total factor productivity. Unlike more simple growth models, LINKAGE has considerably more structure and the full dimension of its data covers a total of 226 countries aggregated into 129 regions or country groupings, and 57 sectors or commodities. This multi-sector and multi-regional configuration permits the analysis of global development and structural transformation, incorporating the complex interactions of productivity differences at the country, sector or factor level, shifts in demand as income rises, demographic and skill dynamics in the factor markets, as well changes in comparative advantage and trade flows from globalization. In practice, aggregation is employed to emphasize the countries or sectors underscored in the analysis. For this study, the list of country or regional units (Table 1) includes all 18 individual African countries currently available in the database at the time of the study, several large countries (such as United States, China, India, Brazil, and Russia), plus various regional subgroups (such as rest of SSA, OPEC, other less developed countries, EU countries, and other high income countries). In addition, 7 sectors are delineated – agriculture, natural resources (excl. oil), oil, food, manufacturing, infrastructure, and services.

Table 1: Country and regional aggregation in the study

United States of America	Ethiopia
EU countries	Kenya
Other high income countries	Madagascar
China	Malawi
India	Mauritius
Brazil	Mozambique
Russia	Tanzania
OPEC countries (excl. Nigeria?)	Uganda
Other less developed countries	Zambia
Cameroon	Zimbabwe
Côte d'Ivoire	Botswana
Ghana	Namibia
Nigeria	South Africa
Senegal	Rest of SSA

[2] See www.gtap.org for details.

To measure the effects of external shocks (or economic policies) on poverty and on the distribution of welfare among individuals and households, the microeconomic simulation in the GIDD (Global Income Distribution Dynamics) framework models how households would react to changes in relative commodity and factor prices generated from LINKAGE, incorporating into the analysis demographic and occupational characteristics of each household (Bourguignon and Bussolo, 2013). Based on the International Income Distribution Database of the World Bank, the GIDD currently includes harmonized household survey data for 121 countries, covering approximately 90 percent of the world's population. The GIDD also allows for the analysis of impacts on global income distribution from global growth scenarios. It also includes the ability to distinguish changes due to shifts in average income between countries from changes attributable to widening disparities within countries.

The baseline scenario

To capture the main global trends and Africa's role in the world economy to 2025, the baseline scenario incorporates key drivers of economic growth including demographic changes, technological catching-up and capital accumulation. The projections are generally consistent with long-term trends used by the World Bank (2013, 2012), adjusted for more recent data up to 2010 and the separation of specific African countries.

The first decade of the 21st century saw an acceleration of growth in developing countries: average growth jumped from 3.3 percent per year during 1980–2000 to 5.8 percent per year in the 2000s. In the baseline scenario, developing countries will continue to grow at an average 5.2 percent a year, compared with 1.7 percent for high-income countries over that period. The slight slowing of developing-country GDP growth in the future is due to aging, slower growth in the labor force, and the slowing of technological progress as the large emerging countries shift towards the production of services. All told, global GDP is expected to grow at an average annual rate of 3 percent between 2010 and 2025.

Measured at constant 2007 prices, the global economy would reach $97 trillion in 2025, up by almost 70 percent from the $60 trillion in 2010. Within the global aggregate, developing countries will more than double their GDP from $18 trillion to $38 trillion (see Figure 1), increasing their global share from 31 percent to 39 percent.[3] China would account for 28 percent of growth in global real output and 43 percent of growth in output of today's low- and middle-income countries up to 2025.

Africa will continue its remarkable rise. The SSA region is expected to double its size from around $1 trillion in 2010 to above $2 trillion in 2025 (measured at constant 2007 prices). Its per capita GDP growth, at 3.1% a year, matches closely the 3.2% performance of other developing countries (Figure 2). No longer lagging, the region is expected to maintain a roughly constant share of the income of developing countries. Its share of the world economy is expected to increase slightly from 1.7% in 2010 to 2.1% in 2025.

[3] Evaluated at 2007 market exchange rates and constant prices. The rapidly emerging economies would normally be associated with rising real exchange rates so that their weight in the global economy will actually be measurably higher in value terms than in constant price volume terms.

Figure 1: GDP level over 2010-2025 (2007 USD trillion)

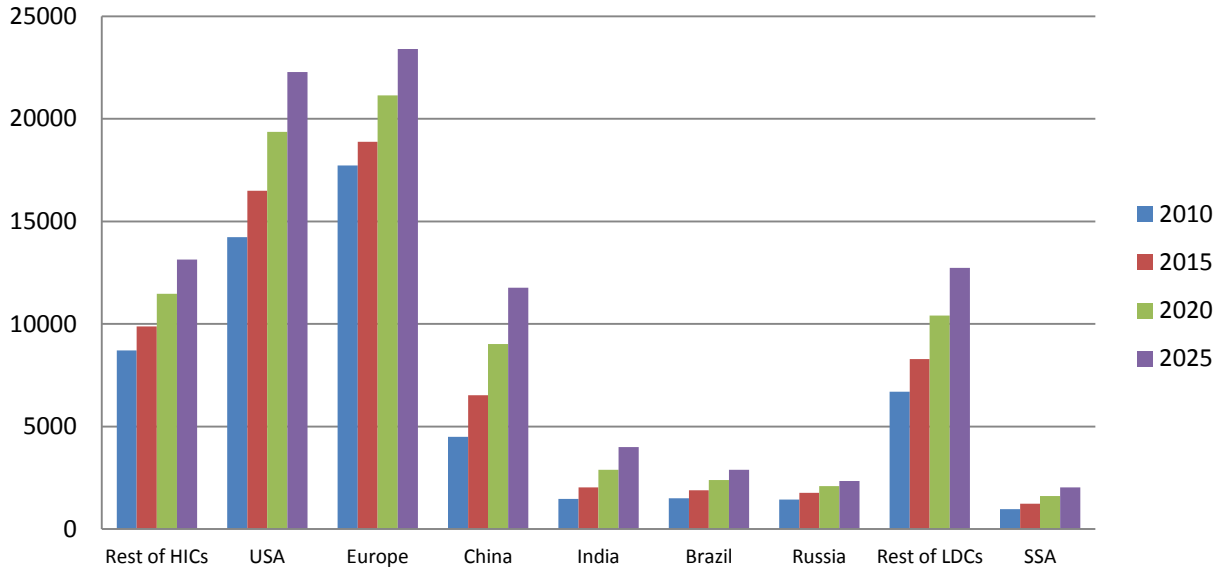
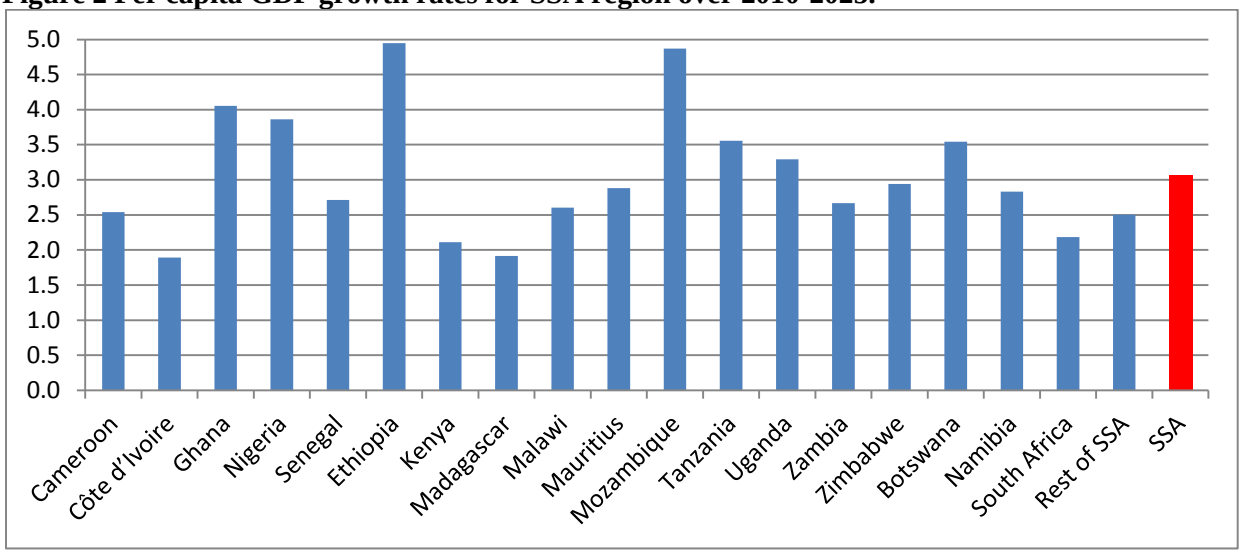


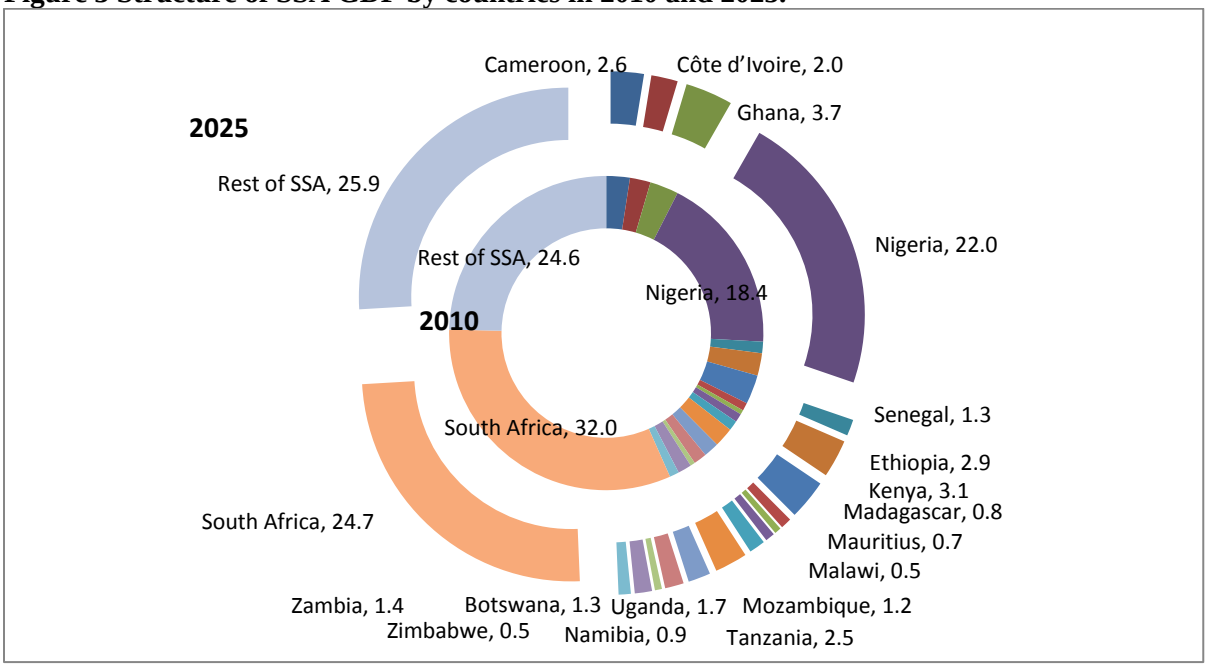
Figure 2 Per capita GDP growth rates for SSA region over 2010-2025.



Source: Authors' simulations and calculations.

Several African countries such as Ethiopia and Mozambique are expected to grow relatively fast, averaging 7% annual growth over 2010-2025. Even though productivity growth has not been very impressive in those two countries and is expected to continue that way, factor accumulation is projected to be very rapid. The average annual growth of the labor force is expected to be around 3% over 2010-2025, while capital accumulation is projected to be above 8%, by far the fastest among all countries. Meanwhile, some countries with relatively fast productivity growth such as Malawi or Zambia are expected to also achieve significant growth of about 6%. Despite faster growth rates in smaller countries, Nigeria and South Africa will still be the two largest economies in 2025 (Figure 3).

Figure 3 Structure of SSA GDP by countries in 2010 and 2025.



Source: Authors' simulations and calculations.

Although developing countries will be growing faster, the gaps in income levels will take longer time to bridge than the 15 years in the baseline scenario. The convergence between developing- and developed-country incomes using 2007 PPP exchange rates[4] is progressing, but at speeds varying significantly across regions. At 2007 PPP exchange rates, the average developing-country resident earns about 17 percent of the average income of high income countries—$5,943 versus $35,302. This ratio would rise to 26 percent in 2025, representing an average developing-country income of $11,188 versus $42,767 for high-income countries. There would be only a modest catch-up in Sub-Saharan Africa. The average SSA resident was receiving about 6% of the income of an average resident of high income countries. By 2025 this ratio would improve to 7.4% with the average SSA resident receiving an income of $3,148. Other developing countries residents' income would improve relatively faster. If China is excluded from the sample of developing countries, the average income of a resident of SSA remains relatively stable as compared to that sample of developing countries with an income equivalent to 38% in 2010 and 36% in 2025.

[4] Using the market dollar exchange rate of an economy provides a biased estimate of individual wellbeing because prices differ substantially across economies—particularly for non-traded goods such as personal and housing services. For this reason, it is more appropriate to use the PPP exchange rates, which take into account these differences in prices.

Figure 4 GDP per capita in 2010 and 2025 (2007 PPP USD in thousands).

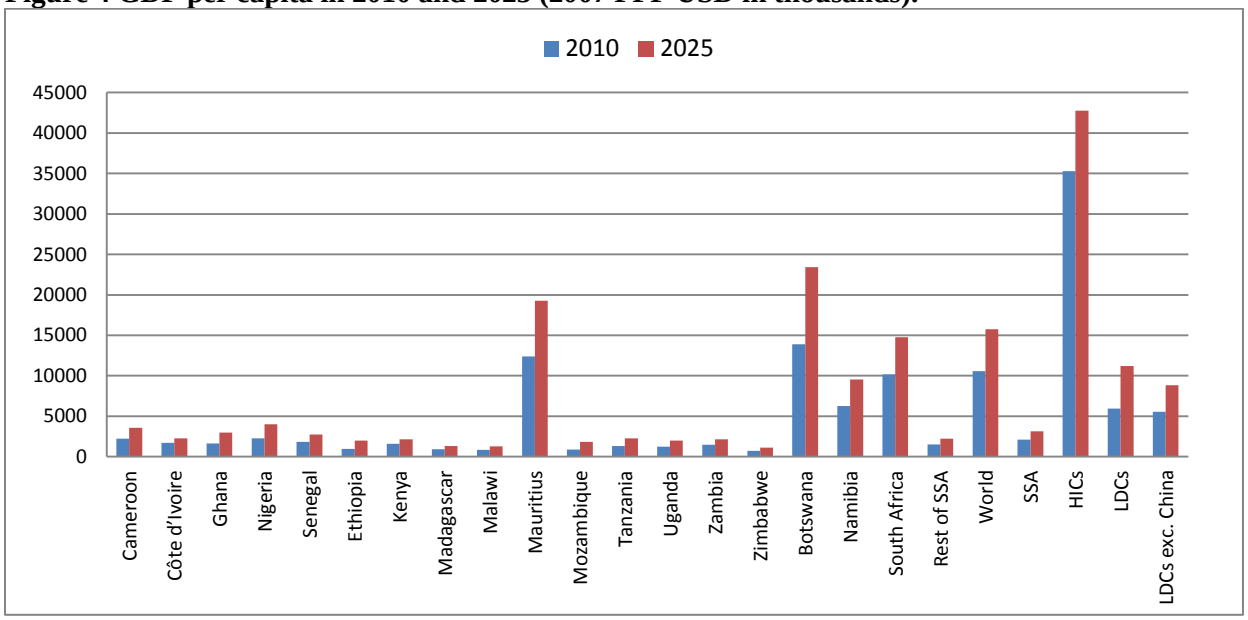
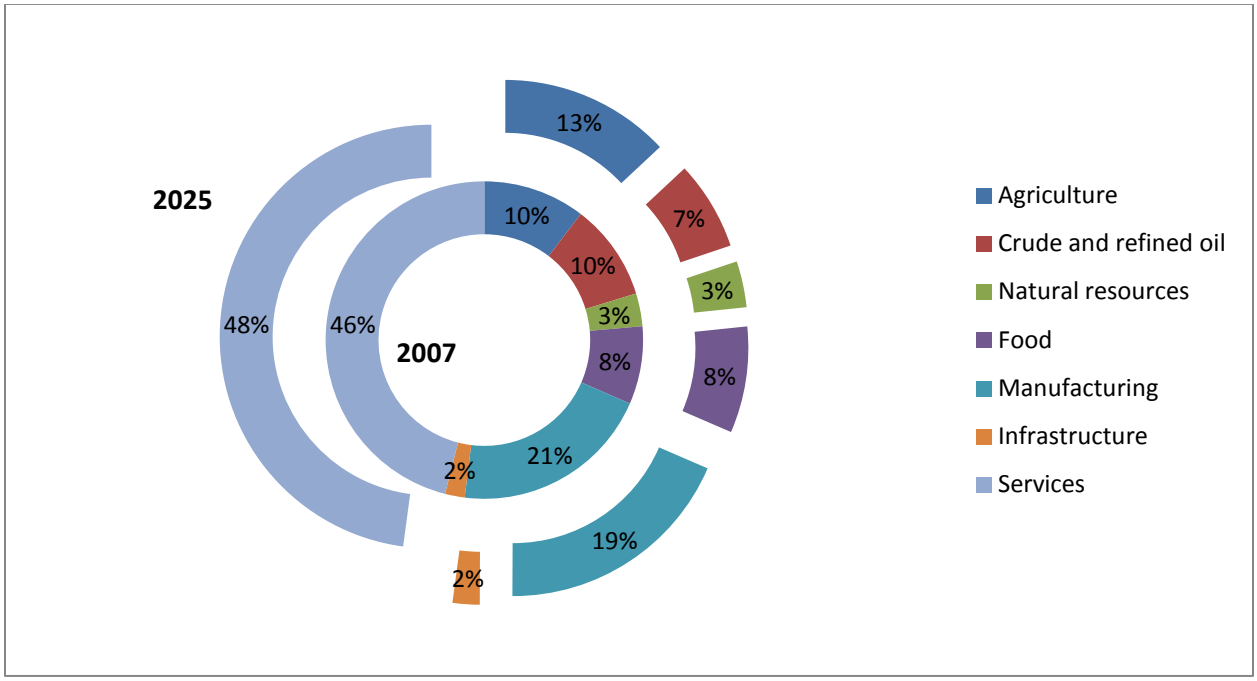


Figure 5 Sectoral structure of SSA output in 2007 and 2025.



Source: Authors' simulations and calculations.

As average incomes of developing countries slowly converge to OECD levels, richer consumers will demand more services, whose income elasticity is greater than one. At the same time, productivity growth in services is generally slower relative to manufacturing and that will contribute to the growing value share of services in output. The increase in prices and demand for services in low- and middle-

income countries, combined with the sustained demand for health and public services by the aging OECD population, is likely to translate into a pronounced shift of production towards services at a global level. The same pattern is observed in Africa. The growing share of services is also associated with a falling contribution of other sectors. In SSA, this is mainly oil sector and manufacturing (see Figure 5).

As a region SSA is expected to trade a lot more with other low- and middle-income countries and also to some extent with its regional partners at the expense of trade with high-income countries. Trade shares of SSA countries within Africa will increase. This is only due to the increase of their significance in the 3 largest economies/regions: South Africa, Nigeria and the rest of Sub-Saharan Africa. For the remaining smaller economies the importance of trade with other countries within the region is expected to decline as they diversify their economies and reduce the initially relatively higher intra-regional trade shares. All countries in SSA are expected to trade a lot more with other lower and medium income countries (LMYs) over time. The share of exports of SSA to LMYs is expected to increase by 17 percentage points from the level of 41 percent in 2007. The share of imports of SSA from LMYs is also expected to expand by 13 percentage points from the level of 46% in 2007.

Figure 6 Income Distribution in SSA in the Baseline.

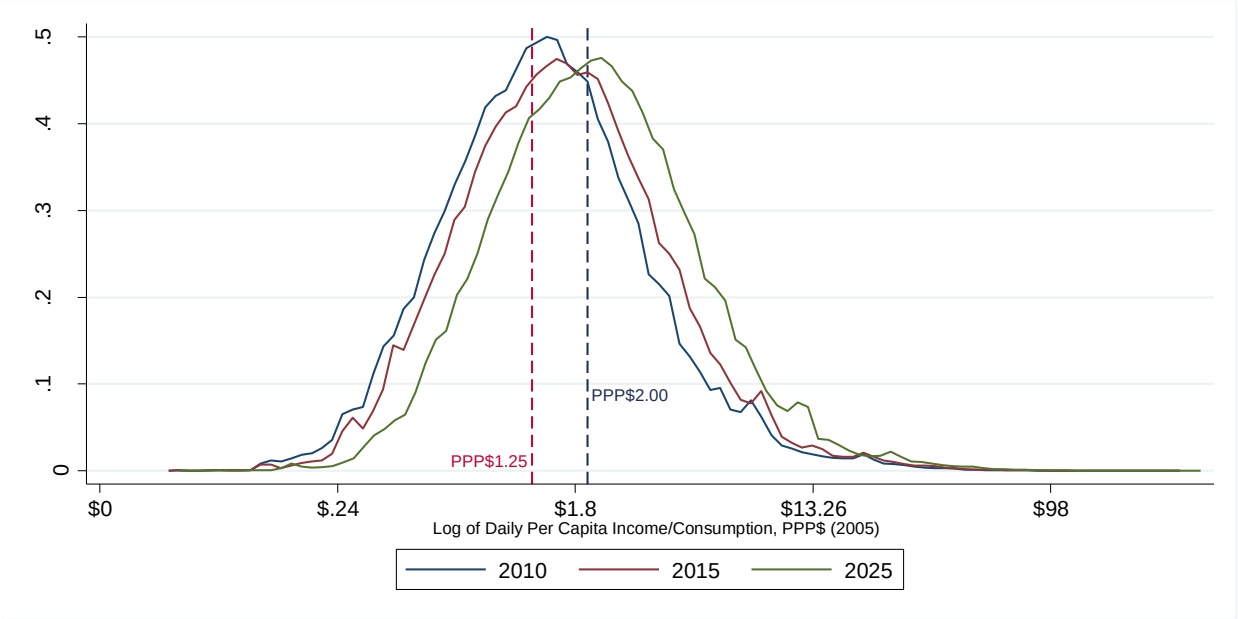


Figure 6 shows the evolution and positive shift towards the right of Sub-Saharan Africa's income distribution under the baseline scenario. From 2010-2015, the region's per capita income grows annually at 3.0 percent, albeit with mixed outcomes within the region likely due to the continuing effects of the slow recovery in high-income countries from the economic recession of 2008-09. Positive growth was largely influenced by some populous countries such as Nigeria (5.28%), Cote d'Ivoire (6.59%), Ethiopia (6.59%), Ghana (3.07%), South Africa (3.03%), and Uganda (2.21%). Even so, income remains stagnant in several countries, with Namibia (-3.47%) and Cameroon (-1.39%) suffering more drastically. As the global economy expands more steadily during 2015-2025, the region's per capita income grows at the long-term rate of 2.75% a year and it is more evenly distributed across countries. Countries that experience negative growth in the first phase resume their growth trajectory at 2.4% a year.

From 2010-2015, the percentage of people living in poverty in SSA will fall by 6.6 and 7.7 percentage points relative to the PPP$1.25/day and PPP$2.00/day poverty lines, respectively. During the following decade, the more evenly distributed growth trajectory will have significant welfare effects - poverty headcounts in Africa will fall by an additional 11.8 and 13.8 percentage points. All told, the poverty rate by 2025 will fall to 30.1 percent relative to the $1.25/day threshold and 43.2 percent relative to the $2.00/day benchmark.

Alternative scenarios: Adverse shocks

Prolonged recession in high-income countries (HICs)

The first stress test is a prolonged recession in the HICs and the results indicate it has negligible impact on SSA. In this scenario GDP per capita growth in the HICs averages 0.6 percent over 2010-2025 or roughly half of the growth rate of the baseline. Real consumption in the HICs drops significantly, while world oil prices drop only slightly as lower demand from high income countries is largely replaced by increasing demand from developing countries in response to lower prices. We note that there is very little impact on SSA in terms of output: the volume of regional GDP in 2025 is less than 0.5% lower than in the baseline with the highest impact on Nigeria being slightly higher than the regional average. Similarly the impact on real consumption is rather small. This is mainly due to terms of trade changes with oil exporters as Nigeria and the rest of SSA losing a bit more of real consumption than other SSA countries (up to 1% by 2025). The results confirm the transformative and enduring change in the global economy, with the rise of emerging market economies like China, India and other developing countries in Africa and elsewhere rising to the helm of the world economy and providing multi-polar sources of global growth (World Bank 2011). In the prolonged recession scenario the world share of SSA in 2025 would reach 2.2%, slightly higher than in the baseline (2.1%). The growth implications of a prolonged recession in the HICs for other developing countries do not exceed 0.5% deviations from the baseline.

Prolonged recession in high-income countries coupled with a collapse of financial flows

However, a prolonged recession in high-income countries that is coupled with a collapse of financial flows could have much larger consequences for SSA. A prolonged recession could trigger renewed financial problems in high-income countries, which could lead to deleveraging globally, and a breakdown in international capital flows. For this scenario to take place we would need to assume rapid financial development in emerging economies that would improve capacity to absorb their capital surpluses. This scenario seems rather adverse, but it is done as a thought experiment to illustrate the importance of capital flows. Without external financing investment in several countries would drop significantly. Even so, a few resource-rich countries with an initial outflow of capital would be forced to invest the excess capital at home and their GDP would likely expand in this scenario. The investment share of GDP by 2025 is expected to be between 3-10 percentage points lower than in the baseline for most SSA countries (see Figure 7). As a result GDP volume in 2025 would be significantly lower for several SSA countries, except for the net capital exporters like Nigeria or Zambia where investment rates go up in the autarkic state. By 2025 regional GDP would be 1.3% lower than in the baseline, but this masks a dramatic drop of the GDP volume of up to 20% in countries such a Malawi and Mauritius, or around 10% in Mozambique, Uganda

and Madagascar. The implications for total consumption are in line with the changes in GDP, but slightly more pronounced. By 2025 regional total consumption would be almost 3 percent lower than in the baseline.

Figure 7 illustrates the changes in real investment, which are only due to the collapse of financial flows. The magnitude of the impact depends on the economic characteristics of various countries – such as the structure of the economy, composition of consumption, evolution of relative prices, demographic development like aging etc. The larger the existing current account deficit, the larger the reduction of capital during the shock and the larger the adverse impact of the shock. For example, with demographic changes very similar to a developed country and an elderly dependency ratio increasing significantly, Mauritius will already experience a significant shortage of domestic saving as a share of GDP and more reliance on capital inflows in the baseline. When coupled with a lack of financial inflows, the further effects on savings results in sharply declining investment as well as income and ultimately lower consumption in this counterfactual scenario (see **Figure 8**).

Figure 7 Deviations of investment share of GDP in the recession scenario with a collapse of financial flows as compared to the baseline (percentage points).

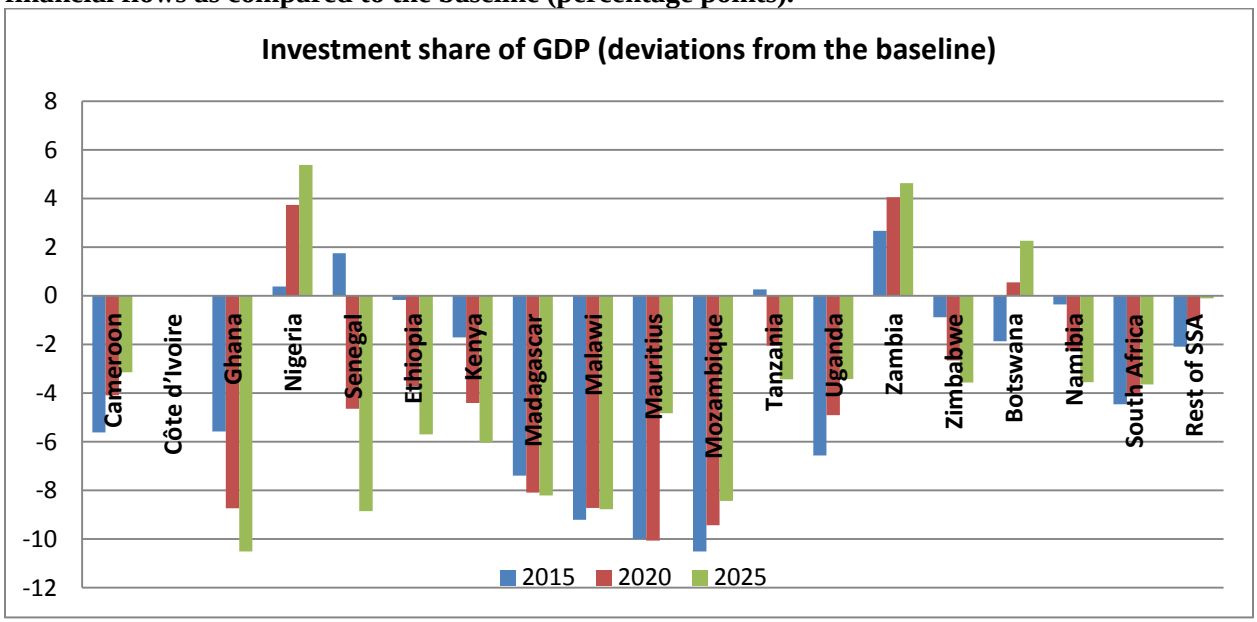
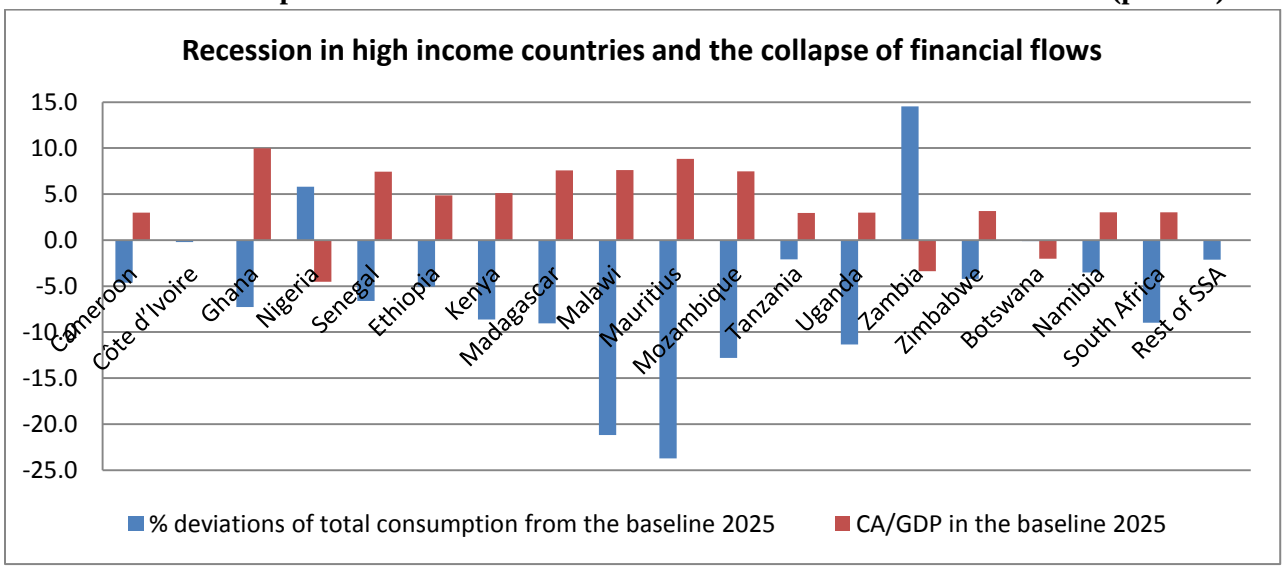


Figure 8 Deviations of real consumption in 2025 in the recession scenario with the collapse of financial flows as compared to the baseline and the current account/GDP in the baseline (percent).



Source: Authors' simulations and calculations.

Oil Supply Shock

In this stress test, we look at the implications of a supply shock in the non-African OPEC countries (that is, all except Nigeria) in 2013. The shock could arise due to a military conflict in the Middle East or some other temporary shock that disrupts the supply of crude and refined oil. In this scenario, oil production in OPEC drops 50% in the first year but recovers over the next couple of years to its pre-shock level. The rise in the world price of oil will encourage other oil producers to step up their production so that the decline in overall world output is mitigated. Even so, these other producers have higher marginal cost or lower productivity so that the world price of oil jumps by 22% initially. The increase in the world oil price benefits several net oil exporters. The changes in real domestic consumption can be traced back to the structure of oil production and consumption. Table 2 displays the benchmark share of imports in consumption and the share of exports in production. Countries such as Mozambique or Zambia that do not have any domestic production, and rely completely on imports of oil, experience a drop in real consumption due to higher prices of oil. On the other hand, oil producers and exporters such as Nigeria or rest of SSA benefit from higher oil prices. The impact on GDP is less pronounced than the impact on real consumption, because the latter is directly affected by terms-of-trade shocks. Due largely to more African countries producing oil, overall GDP of SSA in this scenario by 2025 is slightly higher than in the baseline (1%).

Table 2: Oil supply shock scenario: real consumption deviation from the baseline (percentages) and benchmark oil imports share of consumption and oil exports share of production.

	Real consumption deviation from the baseline (%)				Oil imports share of consumption (%)	Oil exports share of production (%)
	2013	2015	2020	2025	2004	2004
Cameroon	0.7	0.5	0.6	0.8	13	46
Côte d'Ivoire	0.6	0.5	0.4	0.4	26	30
Ghana	-1.0	-0.5	0.1	0.1	100	0
Nigeria	2.5	1.1	0.8	1.0	7	88
Senegal	-0.8	-0.3	0.0	0.1	70	4
Ethiopia	-0.9	-0.5	0.0	0.0	100	0
Kenya	-1.8	-1.0	-0.2	-0.1	100	0
Madagascar	1.6	0.9	0.4	0.4	23	70
Malawi	0.6	-0.2	-0.2	-1.0	25	66
Mauritius	0.6	0.2	0.1	0.1	40	54
Mozambique	-0.6	-0.4	-0.1	-0.1	100	0
Tanzania	-0.8	-0.5	0.0	0.0	100	0
Uganda	1.3	0.6	0.5	0.7	17	70
Zambia	-0.5	-0.4	0.1	0.3	100	0
Zimbabwe	-1.8	-1.4	-0.7	-0.6	100	0
Botswana	-1.0	-0.5	-0.1	-0.1	100	0
Namibia	-1.1	-0.5	-0.2	-0.2	100	0
South Africa	-0.9	-0.6	-0.2	-0.2	43	11
Rest of SSA	4.9	3.0	2.6	3.0	5	81

Source: Authors' simulations and calculations.

Drought

In Africa, droughts are recurrent events with tragic repercussions to the ecosystem, population and governments (Sheffield and Wood, 2011). In a region where the majority of people depend on farming or raising animals, droughts inevitably have very negative consequences. In fact, no region in SSA has been spared over the past 3 decades (Table 3). The most severe drought occurred in the early 1980s with thousands of deaths in Ethiopia and Mozambique and substantial economic damage. The Sahel region of West Africa, which covers parts Senegal, Mauritania, Mali, Algeria, Niger, Chad, Sudan and Eritrea has also experienced many droughts. One of the worst occurred in 1914 but more recent famines between 1968 and 1974 and in 2010 affected large proportions of the population. As recently as 2012, more than 18 million people were hit by food shortages and over 1 million children faced the risk of acute malnutrition[5]. Even though several factors, including international food price movements, have contributed to the crises, low rainfall in the region led to a poor harvest in 2011 and 2012. Grain production in many areas was 36 percent lower than in 2011 and 20 percent lower than the average of the past five years. For example, Senegal's production of ground nuts, one of its main crops, was 59 percent lower than in the previous year.

[5] Metro News, **metro**.co.uk/.../**sahel-drought-in-west-africa-leading-to-crisis-as-millions-of-lives-at-risk**-521534/

Droughts often lead to a substantial reduction of food production and the potential for famines. Even if famine could be avoided, rural output is destroyed and rural income reduced, exacerbating rural poverty. Loayza et.al. (2009) study the impact of natural disasters on economic growth. Findings from a panel of 94 developed and developing countries over 1962-2005 indicate that droughts have a negative impact on economic growth with the largest impact on agricultural growth, but also a statistically significant negative impact on industrial growth and no statistically significant impact on services. They find that in developing countries a typical drought produces a reduction of agricultural and industrial annual growth rate of the order of 1 percentage point, resulting in a decline of GDP of 0.6 percentage points per year or 3 percentage points over a period of 5 years. Clearly the impact of droughts on economic growth is substantial, but given that agricultural and labor intensive sectoral growth is especially important to the poor, the droughts are going to affect poverty disproportionately. Christiaensen, Demery and Jesper (2011) estimate that a 1 percentage point of agricultural growth is three times as effective in reducing poverty in low income SSA as 1 percentage point of GDP growth outside agriculture.

To the best of our knowledge there are only a few CGE-based studies analyzing the implications of drought in SSA. Pauw, Thurlow and van Seventer (2010) study the impact of droughts on sectoral GDP growth in Malawi. The authors find that drought with the probability of occurrence of every 5 years reduces overall agricultural GDP by 1 percent. The more severe the drought, the larger the estimated loss of GDP. A drought that occurs every 25 years could destroy over 20 percent of agricultural GDP. Since forty percent of Malawi's GDP originates in agriculture, such a severe drought could reduce GDP volume by 10 percent.

In our stress-test, we look at the implications of a widespread drought that would occur in two waves. The first wave would hit Cameroon, Cote d'Ivoire, Ghana, Nigeria, Senegal, Ethiopia, Kenya, Tanzania and Uganda over 2013-2015, the second wave of drought would hit all the remaining SSA countries over 2016-2018. In line with previous studies we model drought as a shock to productivity in agriculture. Consistent with similar historical shocks, we choose the level of productivity shock that would reduce agricultural output initially by around 10% compared to the pre-shock level. This corresponds to reducing agricultural productivity in the first year by 15%. Subsequently, productivity recovers to its pre-shock level over the next 2 years. Other assumptions, such as current account developments or productivity growth in other sectors, remain as in the baseline scenario.

Table 3. Droughts in SSA: death toll and economic damage

	Year	Death toll	Damage in thousand USD
Angola	2001	58	
Benin	1983		651
Burundi	2005	120	
Ethiopia	1983	300000	
	1987	367	
	1998		15600
Guinea	1998	12	
Kenya	1999	85	
	2004	80	
	2005	27	
Madagascar	1988	200	
Malawi	2002	500	
Mauritius	1999		175000
Mozambique	1981	100000	
	1991		50000
Namibia	1991		50000
	1998		1000
Nigeria	1983		71103
Rwanda	1989	237	
Somalia	1987	600	
	2000	21	
South Africa	1991		1000000
Swaziland	1983	500	
	1990		1739
Uganda	1998		1600
	1999	115	
	2002	79	
Zimbabwe	1982		1000
	1991		50000

Source: "EM-DAT: The OFDA/CRED International Disaster Database

www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"

The economic impact of a *disaster* usually consists of direct (e.g. damage to infrastructure, crops, housing) and indirect (e.g. loss of revenues, unemployment, market destabilisation) consequences on the local economy. In EM-DAT estimated damage are) given in US$ (‘000). For each disaster, the registered figure corresponds to the damage value at the moment of the event, i.e. the figures are shown true to the year of the event.

Following the drop in agricultural output, prices of agricultural products and food increase much faster than the equivalent baseline numbers. For Nigeria, Ethiopia or Zambia the initial shock results in an increase in agricultural and food prices by an additional 15%. Imports of food products increase significantly to replace domestic output. As productivity drops and food product prices rise, more workers are needed in an attempt to raise production as part of a general-equilibrium effect. Since unskilled workers in rural areas are mainly employed in agricultural production, their wages increase much faster than in the baseline. In the case of Nigeria, for example, wages of unskilled workers jump by 16% in 2013 or during the first year of the negative productivity shock in agriculture.

Figure 9 Impact of drought on agri-food prices relative to the baseline in 2013 and 2016
(first year of the drought in the two sets of countries)

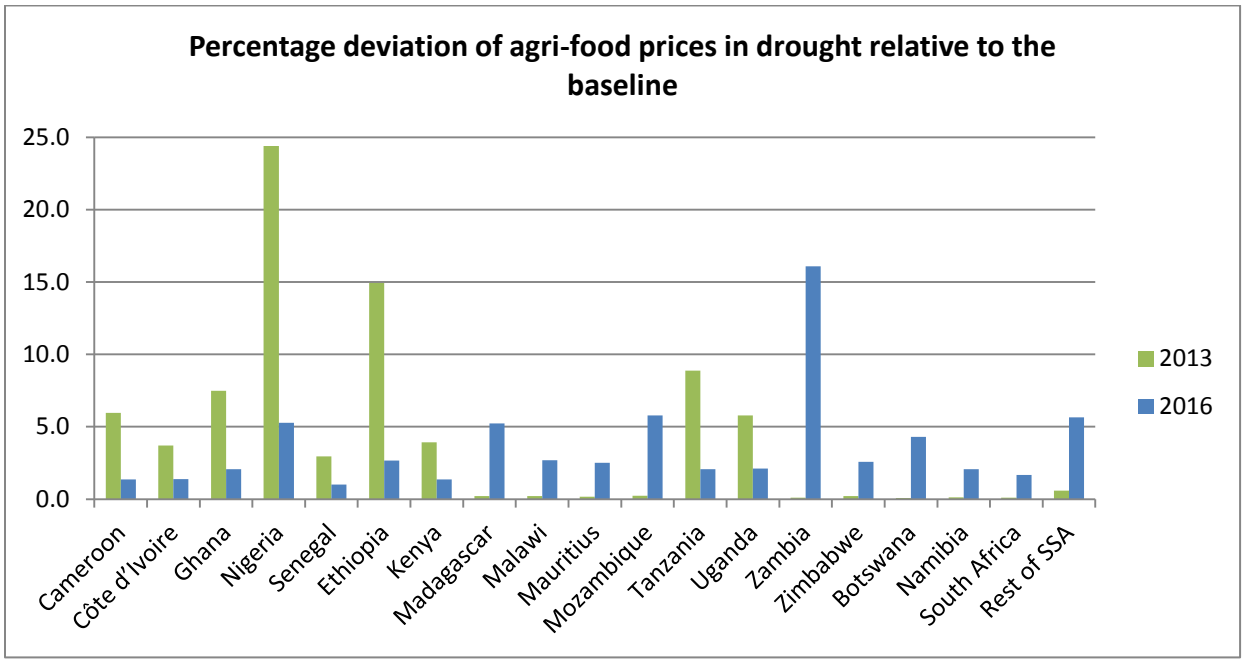
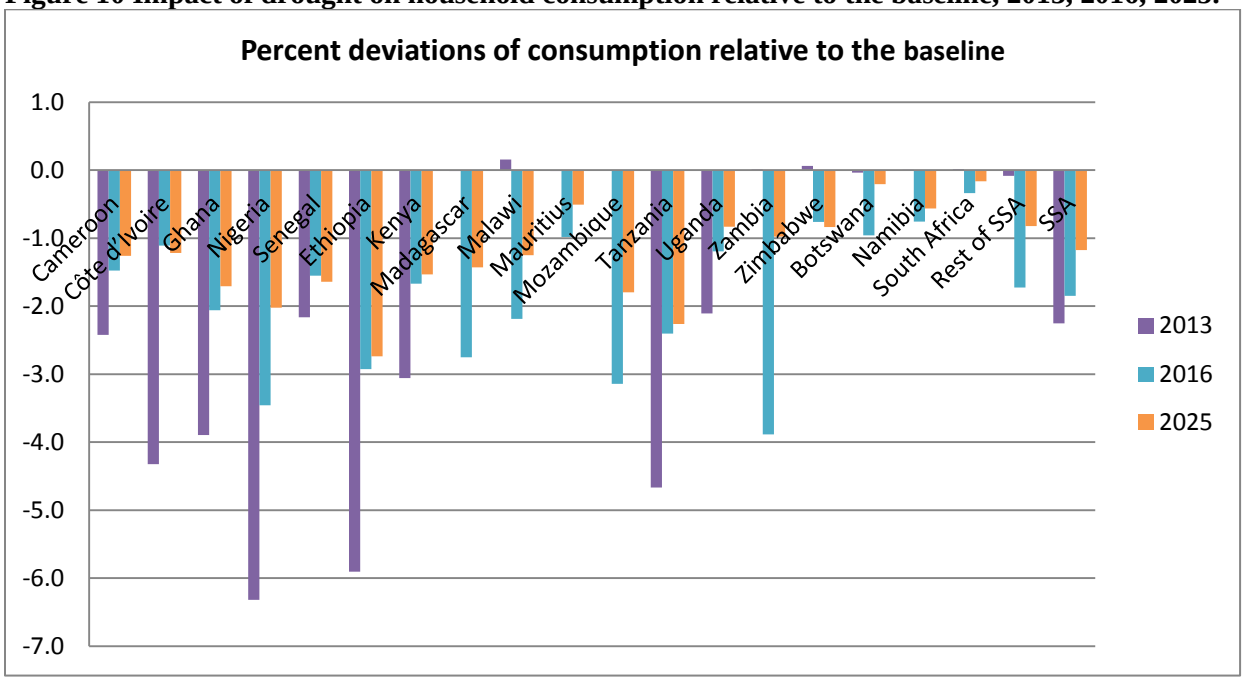


Figure 10 Impact of drought on household consumption relative to the baseline, 2013, 2016, 2025.



Source: Authors' simulations and calculations.

Households will bear the burden of higher food prices. Even though wages of unskilled workers increase, the increase of income is slower than the increase of agri-food prices. Since agri-food expenditures constitute a high share of household budgets, without government or international

intervention real consumption would decrease substantially. The initial loss in household consumption for SSA as a whole would amount to 2.3% in 2013. As agricultural output recovers by 2025, total SSA consumption would be still 1.2% lower than in the baseline. In several countries such as Nigeria where the share of food imports in consumption is relatively high, prices increase substantially while domestic income does not go up as much.

Civil conflicts.

Although declining in frequency, conflict is a significant contributor to growth collapses or decelerations among African countries (Arbache, Go, and Page, 2008). In 2000, for example, one in five people living in Sub-Saharan Africa lived in a country affected by conflict (World Bank, 2000). Nearly 20 countries experienced at least one civil war since 1960. In fragile and conflict-affected states, violence has huge direct social and economic costs, making it the main constraint to meeting the Millennium Development Goals (World Bank 2011b). In neighboring countries, the costs of conflict through refugees, increased military spending, and the disruption of communications routes, trade and investment could also be substantial.

Conflict involves at least three categories of economic cost – the destruction of goods, capital and people; the disruption of present and future economic activities and trade; and the diversion of resources to defense (Anderton and Carter, 2009). In an important study, Collier (1999) distinguishes five channels through which civil war damages the economy. The most pronounced impact is through the destruction of resources. Part of the labor force is killed or emigrates, while physical infrastructure is being destroyed. For major conflicts, like world wars, or civil conflicts of long duration, the death numbers at the macro levels are visibly high. For limited civil conflicts of shorter duration, the macro numbers are less immediately discernible as a percent of the population, e.g. much less than 1% in several cases, but the costs of human lives at the local and micro levels are nonetheless horrendous (see various numbers and implied ratios in Anderton and Carter, 2009). The second impact is the loss of social order and institutional capacity. Economic activity becomes more costly as passing through the country requires extra security and goods are easily stolen. Moreover, provision of public goods becomes much less efficient. The third impact of a civil war is the diversion of public expenditures from output enhancing activities to guns and bullets. Fourthly, temporary income losses often lead to dissaving and further reduction of capital stock. Finally, civil war inevitably leads to financial and human capital flight. Most of these factors will tend to reduce development prospects for many years after the conflict is over.

Although damages can vary by each conflict and its circumstances, Collier (1999) provides some estimates. During civil war, annual economic growth could be reduced by 2.2 percent. It is interesting to note that the length of war has an impact on post-war recovery. After a one-year war, economic growth is likely to continue to decline by 2.1% relative to a no-war scenario. However, after a 15-year civil war, the post-war growth rate is generally 5.9 percent higher. After a short war the capital flight often continues in view of the perceived risk of renewed civil war. After a long war the peace seems to be more stable and repatriation of capital boosts economic growth. Also, the longer the duration of the conflict, the higher of course will be the losses during conflict itself, so the base from which a country grows is lower.

A case in point is the Ugandan civil war that lasted from 1972 to 1986. Collier and Pradhan (1994) report that up to half a million Ugandans lost their lives in the civil war. Some 7% of the

population was displaced as refugees. The economic consequences went much beyond military expenditures and material destruction and triggered the removal of legitimate authority with far-reaching repercussions. Between 1971 and 1986 GDP declined by 13%. The authors estimate that had the Ugandan economy grown at the average of a slow-growing African country, it would have been double its actual size by 1986. As part of the post-war rebound, GDP grew by 37% over 1986-1992. The war resulted in two major shifts in the composition of expenditures. First, investment as a share of GDP fell from 12% in 1971 to 3% in 1978. Secondly, the share of government expenditure in GDP fell from 20% in 1971 to 10% in 1986. Both of these changes have been reversed after the war, with private investment growing at a fast rate. During the war, the change in the composition of output was pronounced. Economic activity moved away from transaction-intensive, transaction-providing and asset-vulnerable sectors and towards low productivity agriculture. Sectors such as manufacturing, commerce or construction lost more than half of their share of GDP, while subsistence agriculture increased its share from 30% to 40% of GDP. These changes were broadly reversed after the war.

In the stress-test scenario, we model hypothetical civil conflicts in three large countries in Africa, Ethiopia, Nigeria and South Africa, lasting three years over 2013-2015. Following the discussion above, the conflict causes loss of life, destruction of capital and collapse of private investment. Domestic production shifts away from manufacturing and services and into subsistence agriculture. To capture the destruction of capital we double the depreciation rates over that period. We also impose an investment-to-GDP ratio at half of the pre-conflict level. The impact of the civil war on the economy is modeled as a negative productivity shock which impacts manufacturing and services to a larger extent than agriculture. Productivity recovers to the pre-conflict level 2 years after the conflict is over. The limited duration of the conflict causes a very slight slowing down of population growth. Other assumptions remain as in the baseline.

While the investment level takes a hit in the conflict years, it quickly recovers to the pre-conflict level and above to rebuild the capital stock destroyed during the war (see Figure 11). With marginal returns to capital much higher following the destruction of a large part of the capital stock, investment growth in the post-conflict years is faster than in the baseline. Even so, the capital stock by 2025 in Nigeria, Ethiopia and South Africa remain respectively about 7, 8, and 4 percent lower than in the baseline. Combined with a negative productivity shock, real GDP in 2015 is about 15 percent lower than in the baseline in Ethiopia and Nigeria. Their eventual recovery still keeps it at about 8 percent below the baseline level. In South Africa where the post-conflict return to capital increases at a much faster rate than in other two countries, the capital stock recovers more quickly and the drop of GDP is not as strong - 4% by 2025 relative to the baseline.

Figure11: Investment share of GDP in the conflict scenario over 2010-2025.

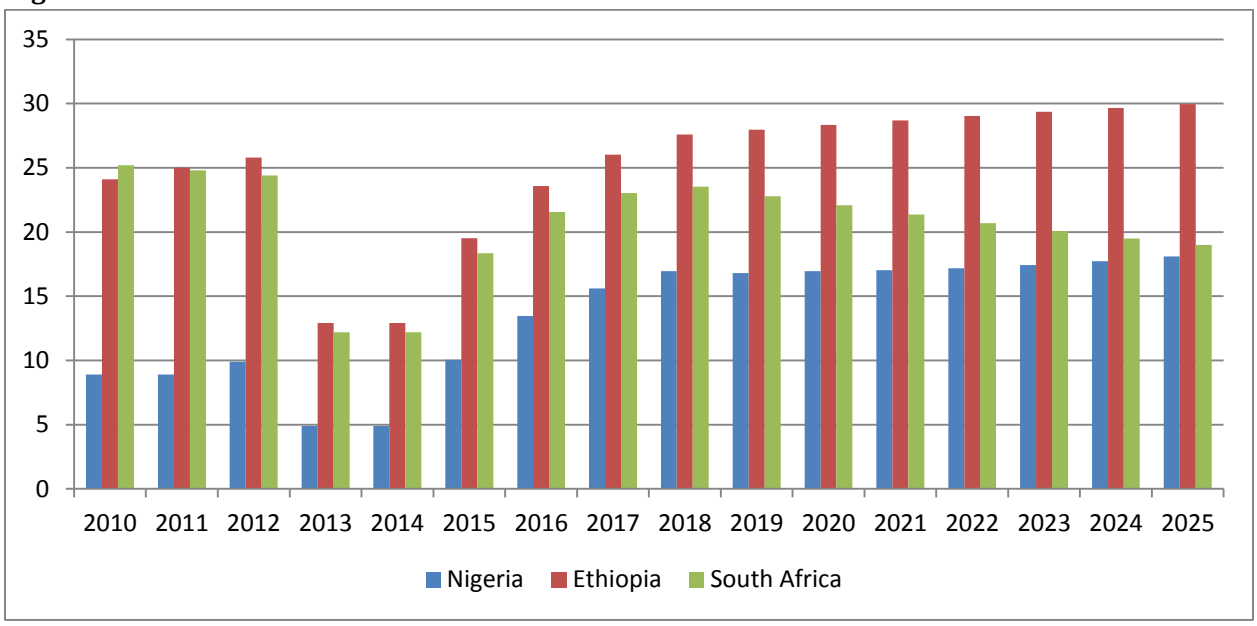
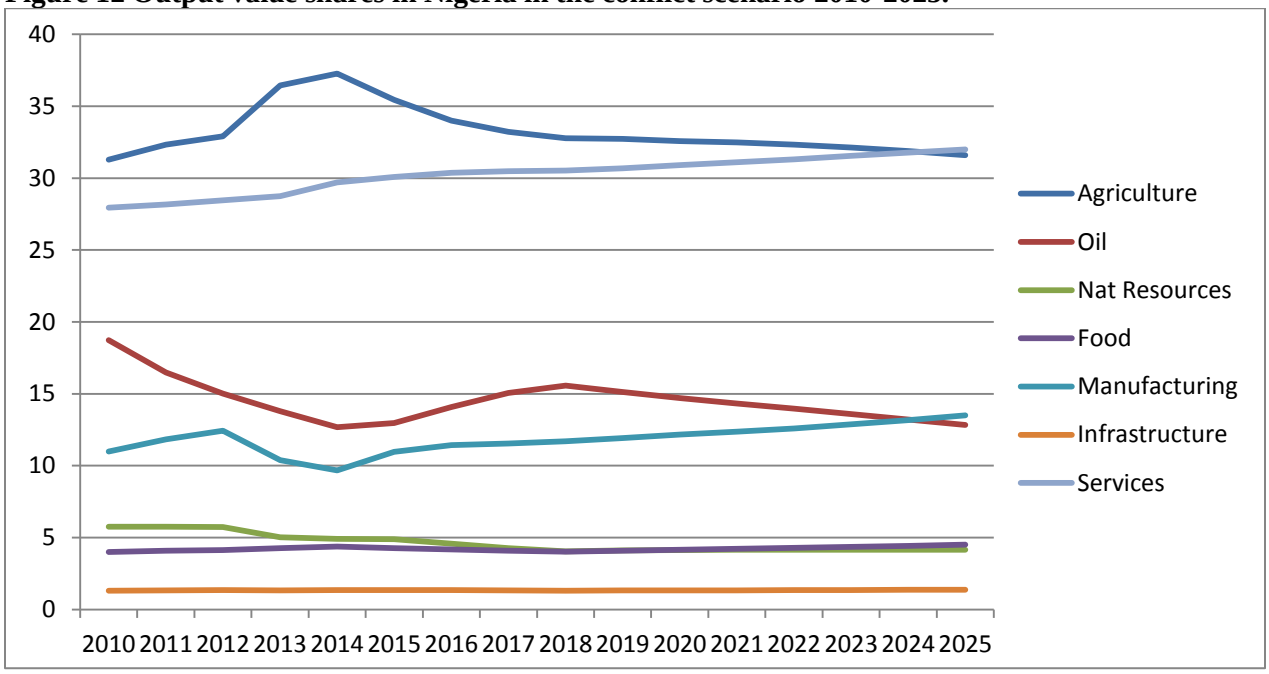


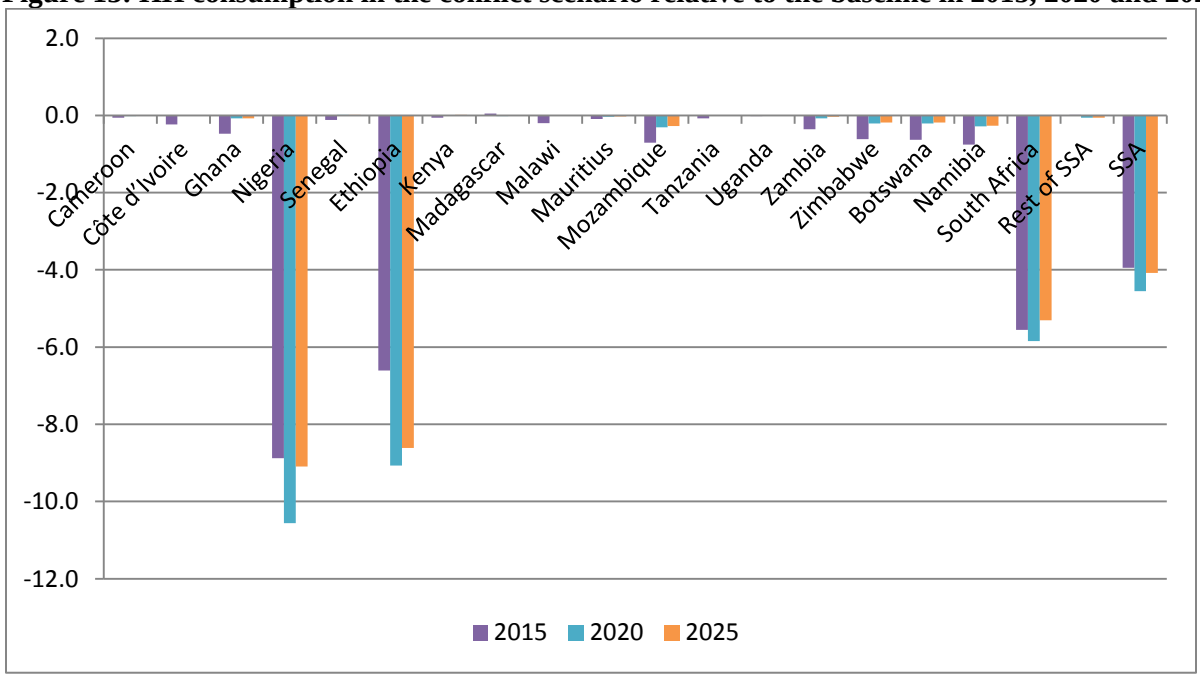
Figure 12 Output value shares in Nigeria in the conflict scenario 2010-2025.



Source: Authors' simulations and calculations.

During the civil conflict, production moves away from services and manufacturing and towards agriculture. The initial sectoral shift is reversed in later years when productivity growth assumptions revert to those from the baseline (see Figure 12). However the initial shift towards agriculture protects the most vulnerable part of the population i.e. unskilled workers, by increasing the demand for their services and therefore wages relative to the baseline.

Figure 13: HH consumption in the conflict scenario relative to the baseline in 2015, 2020 and 2025.



Source: Authors' simulations and calculations.

Finally, consumption at constant prices is a lot lower in that scenario in the countries that undergo the civil conflict, but the negative consequences spill over to all countries across the SSA due to lower demand from the biggest economies of SSA (South Africa and Nigeria). By 2025 overall SSA consumption is still about 4 percent lower than in the baseline. The countries most hit, i.e. those where the civil conflict takes place, record a significant decline of real consumption of between 5% (South Africa) to 10% (Nigeria) as compared to the baseline level.

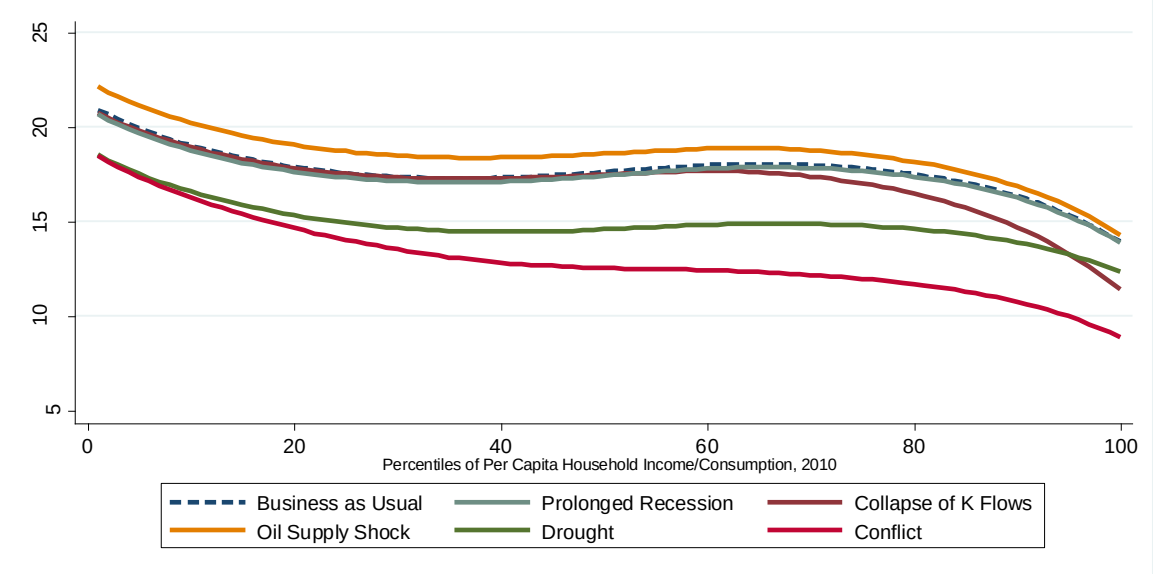
Impact on poverty

To examine poverty and welfare implications of these scenarios, we compare the distributional incidence of the scenarios, including the baseline case, i.e. by looking at growth incidence curves, or the change in income across households at different points in the income distribution. More specifically, for all the scenarios we calculate the post-shock percent change in per capita income across the regional income distribution for all Africa and contrast it to the pre-shock income distribution in 2010. We take the year 2015 for its post-shock income distribution mainly because most of the shocks are introduced in the first few years after 2012. The resulting growth incidence curves are shown in Figure 14, which depict the impact across the 2010 income distribution for the six scenarios.

The first observation is that the curve associated with the baseline case shows a negative slope, indicating overall progressive effects or the inclusiveness of growth, since in general, the poorest households will gain more or do better than the richest by 2015. Despite the generally negative shocks in the alternative scenarios, the inclusiveness of the curve is not completely reversed (see figure 16), but the curve associated with each scenario will shift up and down relative to the reference case, depending on

the severity of the shocks. Comparing across our six scenarios, households in the 6th decile or below would generally not be worse off with a prolonged recession combined with financial flow restrictions to SSA scenarios. This seems to confirm that Africa's growth and poverty performance going forward, as in the recent post-recession period, is generally more robust and relatively "less reliant" on the state of high income countries or the world economy. That said, any drop in financial capital flows will however hit the richer household severely. The opposite is true for droughts, during which the poor are disproportionally hard hit. The dependence on primary exports and commodity prices is still reflected in the growth incidence curve of the Oil supply shock scenario. Unlike the situtation in the 1970s, more and more African countries, including populous ones like Nigeria, are now exporting oil and the benefit of higher oil prices offset their cost effects on production and transportation. By 2015 and relative to the reference case, higher oil prices and production in the oil supply shock scenario are likely to benefit the large majority of the population in SSA. Despite modeling them as shocks that do not deviate significantly from historical magnitudes, the Conflict and Drought scenarios will damage households' welfare the most, confirming that internal shocks like wars and broad food price shocks still pose the greatest risks to Africa's future, as in the past (Arbache et. al. 2008 and Raddatz 2007). Their corresponding incidence curves shift downward significantly across the entire income spectrum.

Figure 14 Growth Incidence Curves for Six Scenarios in SSA, Growth 2015 on 2010



Source: Authors' simulations and calculations.

The good news is that welfare will generally recover by 2025. Figure 15 shows that the growth incidence curves of the alternative scenarios shift back and become more or less congruent to the reference case in 2025. The key assumption of course is that all the shocks are temporary and there is a rebound shortly after the shocks. This means that there are no more external shocks arising from the global economy from 2016 onward. More importantly, the internal shocks such as civil conflicts and drought are all of short duration and their magnitudes are not significantly higher than historical norms for limited shocks.

Figure 15 Growth Incidence Curves for Six Scenarios in SSA, Growth 2025 on 2010

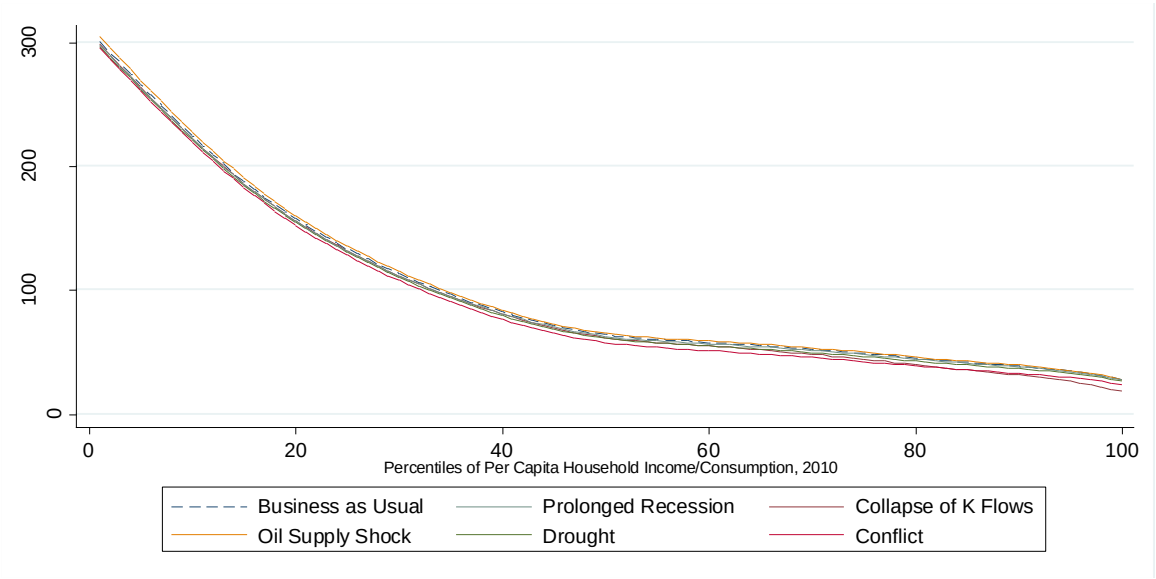
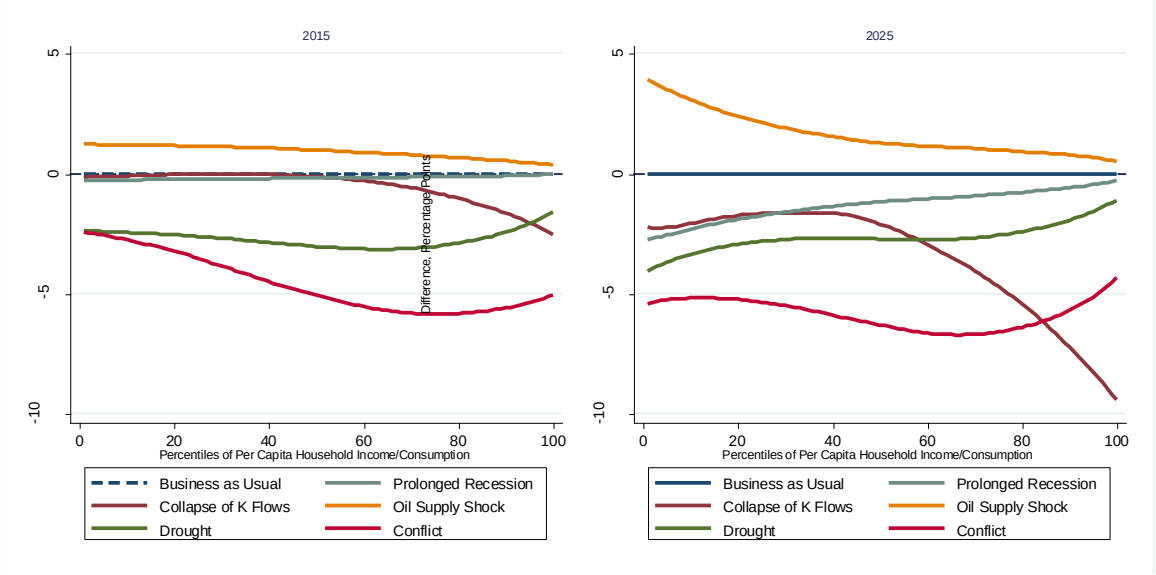


Figure 16 Growth Incidence Differentials between Alternative-Scenarios and Baseline



Source: Authors' simulations and calculations.

Viewed another way, Figure 16 normalizes the Baseline scenario as the benchmark case by setting it to the zero horizontal line. The figure shows the percentage-point differences between the growth incidence curves of our five alternative scenarios relative to the Baseline. The left-panel is derived from the 2015-2010 growth incidence curves, while the right-panel from the 2025-2010 curves. The graph confirms the Oil scenario's largely positive impacts in 2025 (4.25 percentage points above Baseline), and that households in the first two deciles who benefited the most will gain relatively less as

things return to normal by 2025 (1.25 percentage points above Baseline). There are modest differences between the reference case and the cases pertaining to a prolonged recession in high-income countries. The -2.5 percentage point differences relative to the Baseline and that will affect the poorest households in 2025 was non-existent in 2015. In the Conflict and Drought scenarios, that the adverse effects are longer-lasting for all households across the income spectrum are clearly more discernible in this figure. By 2025, there will still be lingering effects of -4.7 and -5.1 percentage points, respectively, with respect to baseline for the poorest 20 percent in SSA.

Table 4 Poverty Headcounts for Six Scenarios in SSA, (%)

		Baseline		Prolonged recession		Collapse of capital flows	
	2010	**2015**	**2025**	**2015**	**2025**	**2015**	**2025**
PPP$1.25/day	48.5	41.9	30.1	42.0	30.4	41.9	30.7
PPP$2.00/day	64.6	57.0	43.2	57.1	43.5	57.1	44.3

		Oil Shock		Drought		Conflict	
	2010	**2015**	**2025**	**2015**	**2025**	**2015**	**2025**
PPP$1.25/day	48.5	41.4	29.7	42.9	30.8	44.0	31.2
PPP$2.00/day	64.6	56.7	42.8	58.2	44.1	59.3	44.8

Source: Authors' simulations and calculations.
Note: The poverty rate projections may differ from other sources such as World Bank (2013). This is because these correspond to the scenarios in this study; they are derived from the micro-simulations in the GIDD model, which does not assume distribution neutrality and will incorporate the general equilibrium effects on relative prices, wages, and quantities.

The overall impact of each scenario on Africa's poverty rate will depend on each household's final position with respect to the poverty line. Table 4 summarizes these effects. Again and by design, the most important differences between Baseline and the alternative scenarios occur in the short-run. The Conflict and Drought scenarios inflict greater damage in terms of forgone poverty reduction – the poverty headcount for PPP$1.25/day is greater than the Baseline by 2.3 and 1.2 percentage points respectively. The Oil scenario provides a slightly positive effect on poverty reduction in both the short and the long-run.

Conclusions

Will Africa's recent and impressive upward trajectory in growth and poverty reduction persist in the long run, especially if the environment turns really negative? The results of the stress tests we introduce in this paper are mixed but cautiously positive. Our findings show that Africa's growth and poverty records are relatively robust to external shocks that arise from the global economy, such as a prolonged recession in high-income countries or even a disruption of capital flows to the region. That conclusion assumes that whatever policy reform achievements as well as economic and trade diversification that were in place

prior to the recession will continue in order to shield economic performance against adverse external shocks.

Internal shocks, such as drought and civil conflicts, will pose the greater risks to Africa's performance. Because of the economic dominance of the agriculture sector and the share of food in household budgets, the region will need to increase the resilience of agriculture against the unfavorable effects of climate change such as drought. And, as in the past, civil conflicts and violence will pose by far the greatest danger to the continent's economic performance.

References

Anderton Charles H. and John R. Carter, 2009. *Principles of Conflict Economics.* Cambridge: Cambridge University Press.

Arbache, Jorge, Delfin S. Go, and John Page, 2008. "Is Africa's Economy at a Turning Point?" In D. Go and J. Page, eds. *Africa at a Turning Point.* Washington DC: The World Bank, pp. 13-85.

Bourguignon, François and Maurizio Bussolo, 2013. "Income Distribution in Computable General Equilibrium Modeling." In P.B. Dixon and D.W. Jorgenson, eds., *Handbook of Computable General Equilibrium Modeling.* North Holland, Elsevier B.V., pp. 1283-1437.

Christiaensen, Luc & Demery, Lionel & Kuhl, Jesper, 2011. "The (evolving) role of agriculture in poverty reduction--An empirical perspective," Journal of Development Economics, Elsevier, vol. 96(2), pages 239-254, November 2011.

Collier, Paul, 1999. "On the Economic Consequences of Civil War." *Oxford Economic Papers.* 51(1), pp. 168-183.

Collier, Paul and Sanjay Pradhan, 1994, 'Economic aspects of the Ugandan Transition to Peace", in D. Bevan et. al, "Some Economic Consequences of the Transition from Civil War to Peace", World Bank Policy Research Working Paper No. 1392.

Loayza, Norman & Olaberria, Eduardo & Rigolini, Jamele & Christiaensen, Luc, 2009. "Natural disasters and growth - going beyond the averages," Policy Research Working Paper Series 4980, The World Bank.

Karl Pauw, James Thurlow and Dirk van Seventer, 2010, Droughts and floods in Malawi, No 962, IFPRI discussion papers from International Food Policy Research Institute (IFPRI).

Raddatz, Claudio, 2007. "Are External Shocks Responsible for the Instability of Output in Low-income Countries?" *Journal of Development Economics* 84(1):155-87.

van der Mensbrugghe, Dominique, 2013. "Modeling the Global Economy – Forward Looking Scenarios for Agriculture." In P.B. Dixon and D.W. Jorgenson, eds., *Handbook of Computable General Equilibrium Modeling.* North Holland, Elsevier B.V., pp. 933-994. See also Van der Mensbrugghe (2011).

van der Mensbrugghe, Dominique. (2011). "Linkage Technical Reference Document." Version 7.1, March 2011, Washington, DC: World Bank. http://siteresources.worldbank.org/INTPROSPECTS/Resources/334934-1314986341738/TechRef7.1_01Mar2011.pdf

World Bank and the IMF, 2013. *Global Monitoring Report 2013:Rural-Urban Dynamics and the Millennium Development Goals*. Washington DC: The World Bank.

World Bank, 2013a. *Global Economic Prospects: Assuring Growth Over the Medium-Term.* Vol. 6, January 2013. Washington DC: The World Bank.

World Bank, 2013b. *Global Development Horizons 2013: Capital for the Future.* Washington DC: The World Bank.

World Bank, 2012. *China 2030: Building a Modern, Harmonious, and Creative High-Income Society*. Washington DC: The World Bank.

World Bank, 2011a. *Global Development Horizons 2011 – Multipolarity: The New Global Economy.* Washington DC: The World Bank.

World Bank, 2011b. *Conflict, Security, and Development*, World Development Report 2011. Washington DC: The World Bank.

World Bank, 2000. *Can Africa Claim the 21st Century?* , Washington DC: The World Bank.