World Economic and Financial Surveys

Regional Economic Outlook

Analytical Note

Regional Inequalities in Sub-Saharan Africa

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Analytical Note Summary

The extent of regional inequality within countries, which is essential for tailoring public policies and programs to lagging regions, is not well documented in sub-Saharan Africa. This study uses various datasets to analyze disparities in level of economic activity, welfare, and social indicators across regions within sub-Saharan African countries. The results indicate that regional inequality declined markedly in the 1990s and the 2000s, due mainly to improvements in economic activity in lagging regions. However, progress has slowed down in the past decade and may have partially reversed during the COVID-19 pandemic. Moreover, sub-Saharan African countries with high regional inequality tend to have high consumption inequality among households. Large disparities between leading and lagging regions in vital socioeconomic aspects persist, including in terms of access to basic services such as education and infrastructure. Evidence shows that macroeconomic stability, trade openness, geographically targeted investments, and strong institutions are associated with lower regional inequality. Concerted policy effort is needed, since addressing regional inequality is important for inclusive growth, poverty reduction, and preserving social cohesion.

Regional Inequalities in Sub-Saharan Africa

SUB-SAHARAN AFRICA'S TAKEOFF: DID THE RISING TIDE LIFT ALL BOATS?

Over the past three decades, many sub-Saharan African countries have achieved headline-making GDP growth. Prior to the pandemic, more than two-thirds of the countries in the region had enjoyed years of uninterrupted growth.[1] Frontier economies such as, Ethiopia, Ghana, and Kenya became growing investment destinations.[2] Ethiopia and Rwanda posted one of the fastest growth rates in the world—an average of more than 7.5 percent per year over the past two decades leading up to the pandemic. Less is known, however, about the extent to which such economic gains have been shared equitably across different regions within each country. Such evidence is important in guiding economic and social redistribution policies to ensure inclusive growth.

The lack of reliable subnational income and output data has been the main hindrance to understanding the evolution of inequality among regions within a country, hereafter regional inequality, in sub-Saharan Africa. In other parts of the world, where subnational GDP data is readily available, there has been mounting research on the extent of and trends in regional inequality. While there is a rich set of literature using regional GDP data to test whether growth in regions within China, India, Thailand, and the United States have converged or diverged over time, much less is known about sub-Saharan Africa.

This study leverages satellite-recorded images of the Earth's nighttime lights (NTLs), used as a proxy for level of economic activity, to assess the extent to which sub-Saharan Africa's strong growth performance has spread across subnational regions. Data from these satellite images allow measuring economic activity at region and district levels within countries. This can be particularly useful in sub-Saharan Africa, where output data by region is often not measured.[3] Throughout this note, economic activity and NTLs are used interchangeably, notwithstanding the caveat that there is considerable noise in the relation between NTLs and output as outlined in Annex 1, and the classification of regions into lagging/poor and leading/rich is based on NTLs per capita. In addition, lagging regions are defined as those with NTLs per capita below the 20th percentile in the nationwide distribution of economic activity, while leading regions are those with NTLs per capita above the 80th percentile of the same nationwide distribution.

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[1] For example, 16 out of 45 countries achieved average growth of more than 5 percent between 2010 and 2019, right before the pandemic. During the same period, the population grew at 2.7 percent, leading to a decent real per capita GDP growth.

[2] The frontier markets/economies refer to the 13 sub-Saharan African countries that have access to capital markets: Angola, Cameroon, Côte d'Ivoire, Ethiopia, Gabon, Ghana, Kenya, Mozambique, Namibia, Nigeria, Senegal, and Zambia as well as South Africa, an emerging market economy.

[3] Satellite-recorded NTL data have been used extensively as a proxy for economic activity. Their linear relationship is well established at national level (Hu and Yao 2021; Beyer and others 2022). In the absence of subnational GDP, their spatial granularity also makes them particularly useful for understanding regional economic activity. As shown in Annex 1, the relationship between NTLs and economic activity at subnational levels is noisy but strong enough to be used as a gauge for the trend of regional inequality. In South Africa, where there is GDP data at regional level, there is a strong correlation between NTLs and GDP per capita. A regression-based prediction of regional GDP per capita, using NTLs as an explanatory variable, shows that the prediction mirrors the actual regional GDP per capital well. In both NTL data and GDP figures, Gauteng Province stands out as the leading region while Eastern Cape is identified as the lagging region.

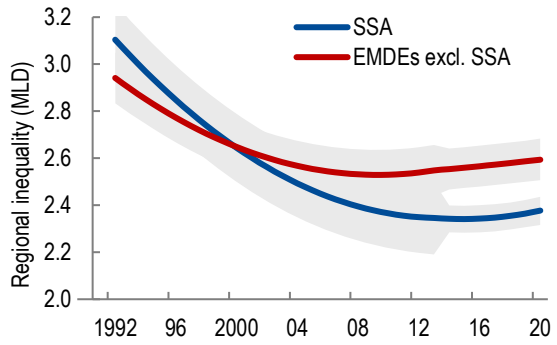
Regional inequality has vital economic and social ramifications. Persistent regional inequality could prop up social discontent and political instability. The study highlights policies and strategies that could help reduce this phenomenon.

LONG-TERM TRENDS: A REMARKABLE CONVERGENCE BUT NOT FOR ALL

NTL data show that sub-Saharan Africa has made tremendous progress in improving regional convergence in economic activity within countries during the 1990s and the 2000s. This is in stark contrast with the trends observed in advanced economies, where regional inequality has been gradually increasing since the 1980s (IMF 2019), and other emerging market and developing economies, where regional convergence has been slower (Figure 1).[4] The rapid regional convergence observed across sub-Saharan Africa is due to faster growth in the poorest regions of each country, with NTLs per capita increasing by several fold in regions that were initially in the lowest quartile of the national NTLs distribution. In other emerging market and developing economies, improvement in NTLs of the lowest quartile was slower, while other quartiles also registered strong growth—limiting the scope for inequality reduction (Figure 2).

Figure 1. Inequality in Economic Activity

Regional inequality has declined faster in sub-Saharan Africa than in emerging market and developing economies…

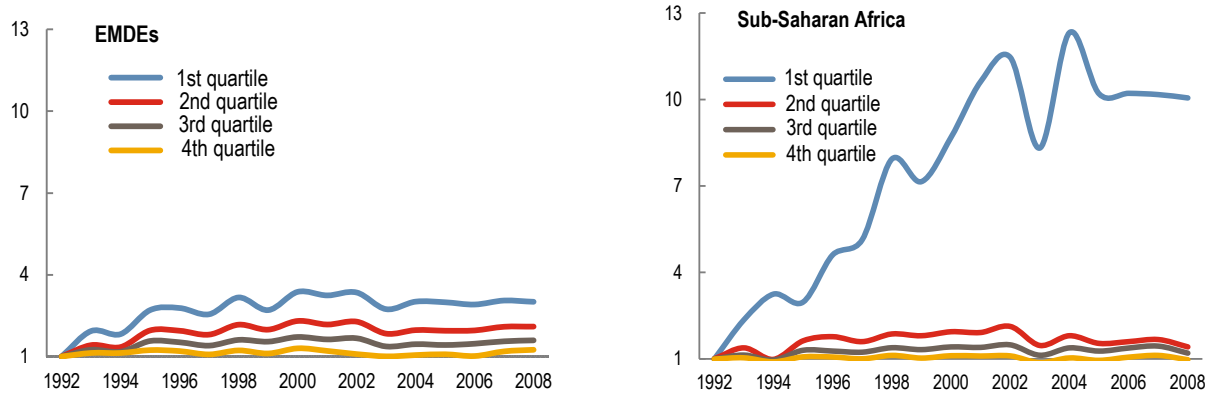


Sources: Earth Observations Group, Colorado School of Mines; and IMF staff calculations.
Note: The figure presents the sub-Saharan Africa average inequality across subnational regions in country. The MLD in nightlights is used as an index for capturing the inequality in economic activity. EMDEs = emerging market and developing economies; MLD = mean log deviation; SSA = Sub-Saharan Africa.

[4] This note uses mean-log deviation (MLD) as the measure of regional inequality within countries. The sum of MLD in NLTs per capita across provinces (the first administrative division) of a country and among districts (the second administrative division) of the same province is used as a measure of overall regional inequality in the country. For detailed description of the methodology for calculating MLD index and a comparison of MLD index with other measures of inequaltity, please refer to Annex 2.

Figure 2. NTLs Per Capita Growth in the Poorest and Richest Regions of Sub-Saharan Africa and other Emerging Market and Developing Economies

The poorest regions registered a faster growth in sub-Saharan Africa than other-emerging market and developing economies



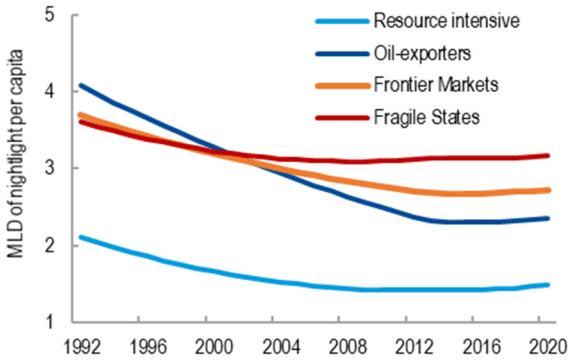
Sources: Earth Observations Group, Colorado School of Mines; and IMF staff calculations.
Note: First quartile refers to the poorest region and fourth quartile refers to the richest region.
EMDEs = emerging market and developing economies; SSA = Sub-Saharan Africa.

Factors contributing to economic convergence include improvements in basic infrastructure, such as increased access to electricity (Botswana, Ghana, Kenya), that have likely helped lagging regions catch up. Population movement to urban centers also supported convergence by reducing NTLs per capita in leading regions. The population residing in the poorest quartile decreased from 27 percent in 1992 to 20 percent in 2013, while those in the richest quartile remained at 28 percent. Mining discovery and the subsequent rapid increase in economic activity in lagging regions with relatively lower population growth (Ghana, Sierra Leone, Tanzania) have also facilitated overall convergence.

There is, however, substantial heterogeneity across sub-Saharan African countries in the extent to which regional inequality has declined. Oil exporters and frontier economies have seen a faster regional convergence than other country groupings (Figure 3). In oil-exporting countries, most of the inequality reduction occurred in the 1990s and 2000s, with the NTLs per capita of the lagging regions increasing by sevenfold, but not much further progress was observed after 2010—in the aftermath of the global financial crisis and the commodity bust of 2008 (Figure Annex 3.1, see Annex 3). Faster growth in regions that were initially in the lowest quartile—and likely with the lowest initial infrastructure access—contributed to a large part of the fast convergence as even a slight improvement in economic development in these regions could increase NTLs per capita by manyfold compared to the effect of a similar level of improvements in the highest quartile (Figure 4 and Figure Annex 3.2).

Figure 3: Heterogenous Changes in Regional Inequality

...inequality declined across the board but much slower in fragile and non-resource-intensive countries.

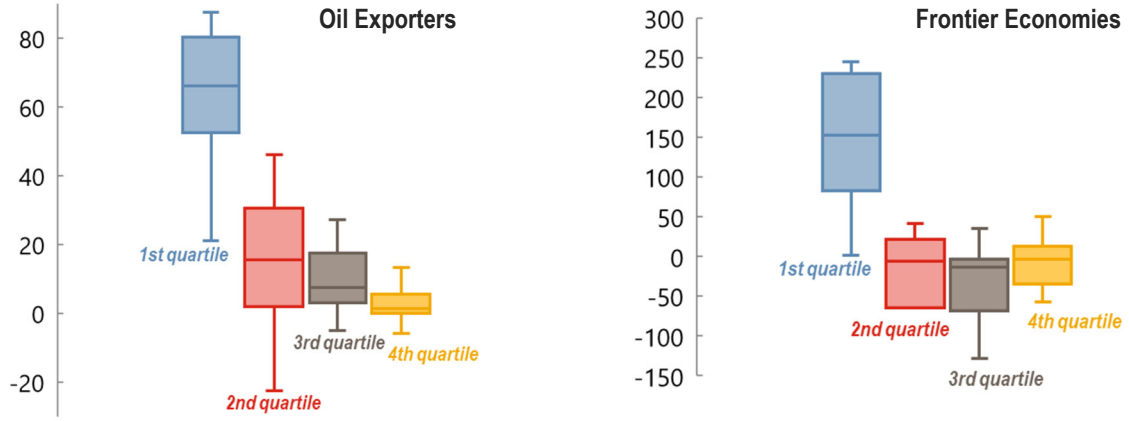


Sources: Earth Observations Group, Colorado School of Mines; and IMF staff calculations.

For the richest regions, declining NTLs per capita signal that infrastructure development and economic growth were incommensurate with population growth, which possibly indicates growing within-region inequality among households (discussed in the next section) as new arrivals to urban centers tend to settle in areas with limited public services and economic opportunities.

Figure 4. Contributions of NTLs Growth in Different Quartiles to Regional Convergence (percent)

Rapid growth of the lagging regions' per capita NTLs contributed a large share of the regional convergence…



Sources: Earth Observations Group, Colorado School of Mines; and IMF staff calculations.
Note: First quartile refers to the poorest region and fourth quartile refers to the richest region.

Similarly, lagging regions in frontier economies have seen a fourfold increase in NTLs, and faster growth in these regions supported convergence until 2010 (Figure 4 and Figure Annex 3.2). The increase in regional inequality in frontier markets after 2013 was again driven by the first quartile, where stalled progress in NTLs per capita resulted in a widening the gap between the first quartile and the national average NTLs per capita.

The regional convergence in NTLs per capita observed in both oil exporters and frontier economies is due to a faster increase in NTLs in the lagging regions, compared to the pace of population increases. The fast NTL growth, compared to population growth, contributed to the large decline in NTL per capita (Figure Annex 3.3).

By contrast, fragile and conflict-affected states (FCS) have made little-to-no improvements in reducing regional inequality (Figure 3). While some minor declines in inequality were registered during the 1990s, the progress halted in the last two decades. This lack of convergence is not surprising, given the adverse factors they face, including natural disasters (Mali, Niger), security and political challenges, and weak institutions (Burundi, Central African Republic, Mali, Togo) as well as limited resources, in most FSCS, to undertake the necessary investments targeted at the lagging regions.

Resource-intensive countries, excluding oil-exporters, have had lower regional inequality since the 1990s, but they have experienced no further reductions since.

COVID-19: LEADING URBAN REGIONS WERE HURT RELATIVELY MORE BUT BOUNCED BACK FASTER

At the initial phase of the pandemic in 2020, regional inequality in sub-Saharan Africa declined temporarily as richer regions experienced faster decreases in economic activity. This is not surprising given that in many countries in sub-Saharan Africa and across the world, regions with high population density, typically urban areas, experienced larger decreases in economic activity as the services sector, which has been the engine of growth and a major source of livelihoods in urban centers, was brought to a standstill. Results from World Bank-supported telephone surveys show that agriculture, which is the prominent source of employment in lagging rural regions, has been resilient because of favorable weather, and it might even have provided alternative livelihood options as other activities slowed down (Amankwah and Gourlay 2021; Amankwah and others 2021).

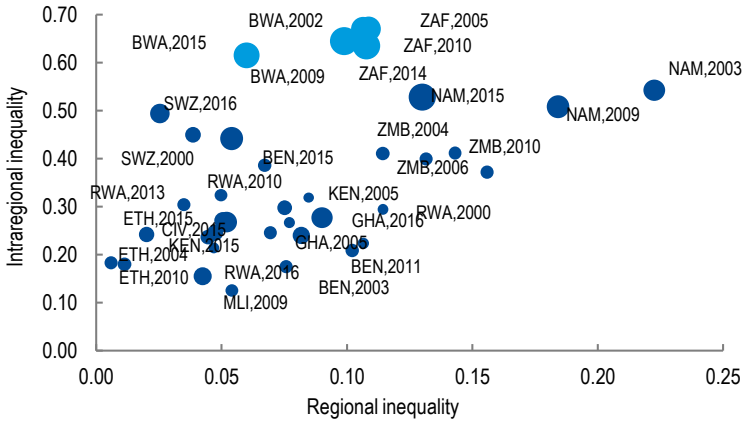
However, the decline in regional inequality was short-lived. For most sub-Saharan African countries, inequality increased slightly in 2020–21 from 2018–19. (Figure 1.2 Box 1). This may be because of differences in the capacity of lagging and leading regions to rebound from the pandemic, leading to the worsening of inequality in some countries.

PERSISTENT SOCIOECONOMIC DIVERGENCE

While regional inequality in economic activity has fallen over time, socioeconomic inequality across households within regions remains very high throughout sub-Saharan Africa. The continent's remarkable reduction in regional inequality is a step in the right direction but reducing regional inequality—without addressing welfare/consumption inequality among regions' residents—would not be sufficient to achieve inclusive growth. Over the last two decades, for example, there has only been a slight change in welfare inequality in sub-Saharan African countries (Figure 5).[5]

Figure 5. Regional and Intraregional Inequality

Intraregional inequality is higher in countries with high regional inequality….



Sources: Household budget surveys from the National Statistics Offices; and IMF staff calculations
Note: Intraregional inequality refers to inequality in consumption per capita (MLD) among households residing in the same region of a country. Regional inequality is also based on average per capital consumption of households in each region. The bubble size reflects income/consumption per capita levels in the country. The International Organization for Standardization (ISO) country codes are shown along with the year when the corresponding household survey was conducted.

In addition, the magnitude of intraregional welfare/consumption inequality among households is still high, especially compared to the average household consumption inequality across regions in each sub-Saharan African country. This is noticeable, for example, in Figure 5 by comparing the scales on the vertical axis, where intraregional inequality is shown, and that of the horizontal axis, which depicts inequality across regions. Furthermore, intraregional inequality is also high in countries where regional inequality is already high (Namibia, South Africa, Zambia)—widening overall inequality further (Figure Annex 3.4). When

[5] Furthermore, in terms of welfare inequality—as measured by the Gini index—sub-Saharan African countries, especially those in Southern Africa, dominate the global ranking. Based on the latest available household survey data, the region is home to the world's most unequal countries (Namibia, South Africa, and Zambia).

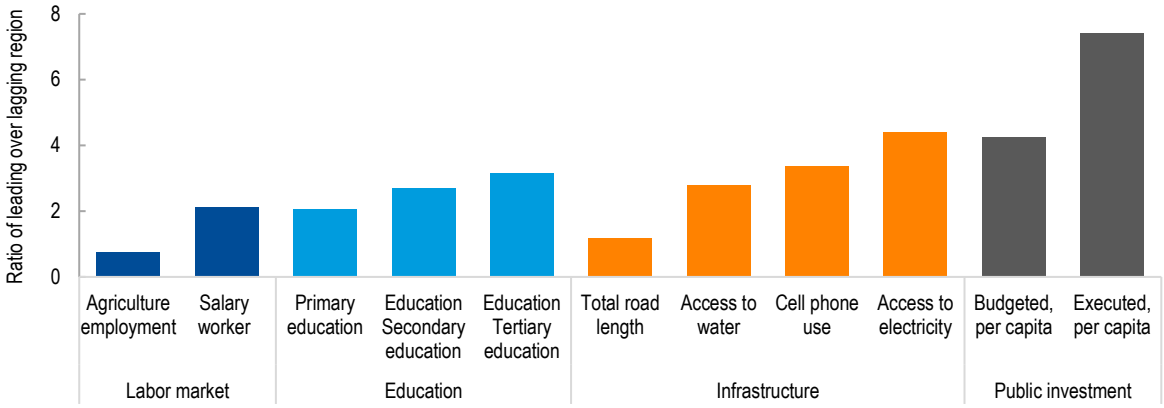
intraregional inequality and levels of income/consumption per capita in the region are compared, the relatively richer regions of each country have higher intraregional inequality (Figure Annex 3.4).[6]

Tackling inequality therefore requires not only well-targeted interventions to reduce regional inequality but also addressing intraregional inequality. For example, in Namibia, regional inequality had been declining continuously until 2015, coinciding with robust economic growth of 4.2 percent that expanded the pool of income. The decrease in regional inequality, from its initial elevated level, has been broad-based, and the leading-lagging gap has shrunk. Intraregional inequality, on the other hand, has not changed much during this period, with welfare inequality between residents of urban centers remaining much higher than the rural-urban divide. Furthermore, after 2015, as the country consolidated to maintain fiscal sustainability, growth became anemic, shrinking the total available output for distribution, and inequality also increased as economic activity tended to be concentrated around the capital, Windhoek.

Regional inequality may occur naturally with rapid urbanization, or it could be the outcome of national development strategies that encourage industrial and service sector development. Even if not all regional inequalities are undesirable, they are typically associated with large disparities in social outcomes, including access to basic services. Lagging regions tend to do worse on key social indicators such as education, communication, and transportation infrastructure, and on labor market outcomes (Figure 6).

Figure 6. Socioeconomic Indicators in Sub-Saharan Africa Leading and Lagging Regions

There are large regional disparities in social indicators…



Sources: Earth Observations Group, Colorado School of Mines; IPUMS; World Bank; and IMF staff calculations.
Note: Only 12 countries publish their public budgets at the regional level, and those budgets were matched to subnational regions in 8 countries.

[6] Intraregional inequality, as measured by the mean long deviation in consumption per capita of households, compares several representative households in a region, and hence it is expected to be generally higher than regional inequality that compares a handful of regions in the country. It also varies considerably across sub-Saharan African countries, and it is positively associated with regional inequality. There is also a strong positive association between intraregional inequality and consumption/income level of the regions, but it weakens at higher income levels (Figure Annex 3.4). This finding is consistent with Kuznets' hypothesis (Haughton and Khandker 2009). Finally, intraregional welfare inequality is different from NTL-based regional inequality, which compares economic activity across regions. These two measures of inequality are not necessarily correlated, that is, a country with a low level of regional inequality could have high intraregional inequality and vice versa. If the gains from elevated economic activity are not equitably shared among residents of a region, the low regional inequality in economic activity might not fully translate into inclusive growth. Furthermore, policies that could rectify regional inequality might also not be effective in addressing intraregional inequality.

The regional disparities are most visible in the access to basic infrastructure, which is at least three times higher in leading regions than in lagging regions. Access to clean water, electricity, and cellphone services is two to four times higher in leading regions. Similarly, there are wide gaps in educational attainment, with a larger share of residents having completed at least primary and secondary education in the leading regions. The gap is even wider for tertiary education. These disparities may emanate from an uneven allocation of public resources. For example, executed public investment per capita is seven times higher in leading regions than in lagging regions (Figure 6). In the eight sub-Saharan African countries that had approved and executed subnational budgets analyzed in this study, the per capita budget approved for lagging-regions was four times lower than that of the leading regions. The gap widens further during budget execution.

Disparities in social outcomes across regions are much larger in some sub-Saharan African countries. In general, the leading-lagging region divide in access to basic services is smaller in Botswana and South Africa—where access to services such as electricity is widespread across regions—as well as in Malawi, where access is limited in all regions. On the other hand, gaps in access to services are much larger in Burkina Faso and Mozambique, where access is generally low, and distribution is also very unequal. For example, access to electricity is nearly 20 times higher in leading regions than in lagging regions in Burkina Faso. Heterogeneity in educational outcomes is quite pronounced as well. For similar reasons, regional disparity in secondary education is lower in Botswana, Malawi, and South Africa, compared to the gaps observed in Burkina Faso and Mozambique (Figure Annex 3.5).

Finally, formal employment in the services and industrial sectors is twice as low in lagging regions across SSA countries (Figure 6). This could partly be due to the rural nature of lagging regions, where more than 80 percent of the population resides in predominantly rural settings compared to only 51 percent in leading regions. Reflective of the rural nature, agriculture is the main sector of employment, and it accounts for 65 percent of the labor force in lagging regions, compared to 43 percent in leading regions.

KEY DRIVERS OF REGIONAL INEQUALITY

Macroeconomic stability, openness to international trade, strong institutions, and well-targeted investments are found to be strongly associated with low regional inequality in sub-Saharan Africa. Table Annex 3.1 presents results from a panel fixed-effects regression model, estimating the drivers of regional inequality in economic activity. The results show a significant positive association between high regional inequality and indicators of macroeconomic instability, such as high inflation, which increases regional inequality through several channels. First, persistent inflation erodes the purchasing power of the poor and vulnerable groups who are more likely to live in lagging regions. These populations in lagging regions lack the means to preserve their purchasing power. With limited local production capacity, they are more reliant on other regions for their basic needs and would be more adversely affected by price surges. Meanwhile, the budget constraint for these populations is often close to binding and further erosion of purchasing power will reduce their savings for production purposes, exacerbating the income gap with richer regions. Furthermore, high inflation reduces government spending in real terms, which disproportionately affects lagging regions that already receive lower budget allocations. Finally, high inflation distorts private investment decisions, often directing firms to richer regions where they are more likely to obtain positive returns.

Trade openness reduces regional inequality through its impact on the agglomeration of activity and relative prices of resources. Better access to international trade can lead to an agglomeration of activity around major cities, which in turn, attracts workers to urban centers—leading to a decline in NTLs per capita of

leading regions as urban population increases but infrastructure development and overall increase in economic activity are unable to keep up. Furthermore, trade openness could lower regional inequality by increasing the value of abundant resources, such as labor and raw materials in lagging regions, supporting their ability to catch up.

Countries with strong institutions and political stability have registered a lower regional inequality. Improved regulatory quality is associated with lower regional inequality, possibly driven by improvements in economic performance, effective public services delivery, and equitable resource allocation (Chong and Calderon 2000). In the absence of a supportive regulator environment and well-functioning institutions, business could concentrate their activities in and around major cities, which are typically in the leading regions, widening regional divergence. Countries that are prone to civil conflicts tend to have a larger regional inequality because of damaged infrastructure and dampening economic activity in lagging regions. Besides, civil conflicts impede the capacity of governments to provide services in conflict zones and to some populations, raising the possibility that some regions could be left behind. But it is also possible that high and persistent inequality could lead to civil conflicts as dissatisfied residents of lagging regions express their discontent.

Well-targeted investments that support lagging regions by creating jobs and promoting economic activity therein help reduce regional inequality. The effect of investments may depend on the sectors into which investments flow and the location of investment projects. For instance, if the investment is targeted at the poorest regions, it could help support regional convergence. In the absence of detailed data on private and public investments at subnational levels, the discovery of minerals was used as a proxy for targeted investments. The investments triggered by mineral and oil discoveries were used to analyze the impact of targeted private and public investments on regional inequality (see Box 2). Increased investments following the discovery of minerals, with a lag of up to four years, are found to reduce inequality. One explanation for this result is that urban/rural inequality is extremely high in sub-Saharan Africa, with most of the economic activity being concentrated in and around the capital cities. However, most mineral discoveries occur outside of the capital cities. During the investment period and before production begins, the region where the discovery happens will receive considerable private and public investments and hence, tends to experience elevated economic activity. However, this effect is limited to the pre-production period and ignores the effect on intraregional inequality or the local social and environmental costs of mineral production.

POLICIES TO TACKLE REGIONAL INEQUALITIES

Tackling regional inequality and building a more equitable future for sub-Saharan Africa requires a broad-based policy framework anchored around four main pillars: implementing redistributive fiscal policy; ensuring macroeconomic and political stability; investing in underserved regions; and improving data collection and reporting capacity at the regional level.

First, governments could pursue redistributive fiscal policy and ensure an equitable budget allocation that helps balance fiscal capacity across regions, enabling the lagging regions to catch up with the frontier regions.[7] Promoting the harmonization of public service delivery across regions would also facilitate convergence in social indicators.[8] Second, enhancing macroeconomic stability is important not only for growth but also for ensuring that growth is inclusive. Supporting good governance and building resilience

[7] For more information on the choice of fiscal policies to tackle regional inequality, please see Gbohoui and others (2019).

[8] Without such intervention, the divergences will only be reinforced. Box 3 provides some country case examples of policies and strategies perused to promote inclusive growth.

in conflict and fragile countries would also help reduce regional inequalities. Third, governments can implement targeted policies or improving infrastructure to attract private investment and promote job-rich economic activity into lagging regions, which would have a multiplier effect and facilitate their catch up.

Finally, there is a need for improving capacity to collect and analyze data at the subnational level as well as building local administrative capacity. This study found that only 12 sub-Saharan African countries publish their public budget allocations at the subnational level, so proxy indicators, such as satellite imagery and mining discovery time and location had to be used to understand economic activity at the subnational level in other countries. Compiling and publishing economic, financial, and social data at the subnational level would help provide a more accurate picture of disparities across regions.

Analytical Note Boxes

BOX 1: CHANGES IN REGIONAL INEQUALITY DURING THE COVID-19 PANDEMIC (2018–21)

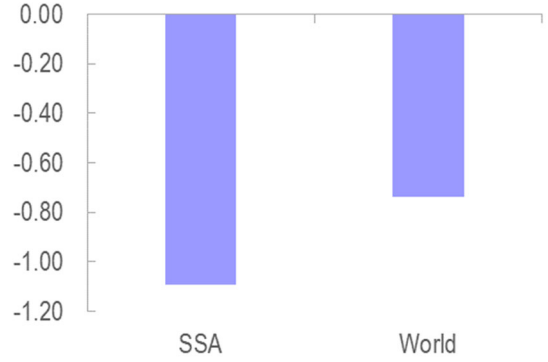
The COVID-19 pandemic has had a devasting impact on economic activity and livelihoods in sub-Saharan Africa. Many countries in the continent have registered their worst growth outcomes in decades, eroding hard-won development gains of the past decade. As shown in the analysis below, the negative impact might have been unequal across different regions.

At the initial phase of the pandemic in 2020, regions that had higher initial nighttime lights (NTLs) per capita experienced larger reductions in economic activity. A regression of NLTs per capita growth recorded during January-December 2020 on initial levels of per capita NTLs (2013-2019 average) show that a 10 percent higher initial average NTLs per capita was associated with 1 percentage point lower GDP growth in 2020 (Figure 1.1 Box 1), leading to reductions in regional inequality. However, this decline was reversed later, and for most countries in sub-Saharan Africa, regional inequality increased slightly in 2020-21 from 2018-19. Figure 1.2 Box.1 presents changes in regional inequality in economic activity—proxied by the mean log deviation (MLD) of NTLs—from 2018 to 2021. Even before the COVID-19 pandemic, there was huge heterogeneity in regional inequality across different sub-Saharan African countries, reflecting the uneven nature of regional inequality problems. The pandemic may have reinforced the inequality problem.

The difference in the capacity of poor and well-off regions to cope with the pandemic-induced slowdown in economic activity has likely reinforced the regional income status. However, the lagging rural regions that rely on agriculture might not have been severely affected. Therefore, the overall regional inequality outcome could be ambiguous. The analysis shows that regions with high population density, typically urban areas, have experienced larger decreases in economic activity. Similarly, regions with initially higher levels of economic activity have registered lower activity since the start of pandemic. When it comes to coping ability, after the onset of the COVID-19 pandemic, wealthier regions were more likely to have the option of remote working, which could help reduce the impact of the pandemic, while poorer regions

Figure 1.1. Change in Regional GDP during COVID-19 Relative to Initial NTLs Per Capita Level, 2020

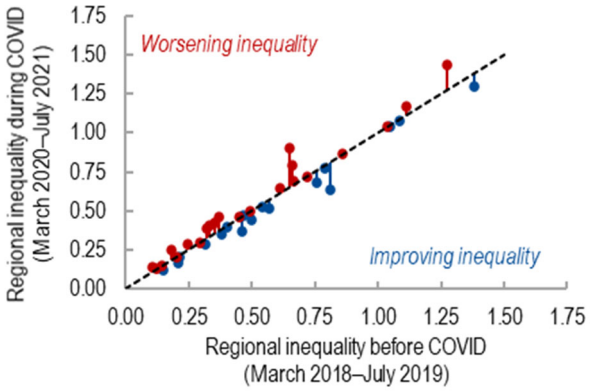
Reversal of inequality during the early phase of the pandemic, especially so in sub-Saharan Africa.



Sources: Earth Observations Group, Colorado School of Mines; and IMF staff calculations.
Note: SSA = Sub-Saharan Africa. The result is from a regression analysis with a dependent variable of NTLs per capita growth in subnational region (proxy for regional GDP growth) between January and December 2020 regressed on initial level of NTLs per capita in the region (2013-2019).

Figure 1.2. Sub-Saharan Africa: Regional Inequality, 2018/19–2020/2

Regional Inequalities has increased in several sub-Saharan African countries during the pandemic.



Sources: Earth Observations Group, Colorado School of Mines; and IMF staff calculations.
Note: Each dot represents a country in sub-Saharan Africa. The black dotted line is a 45-degree line showing no change in inequality.

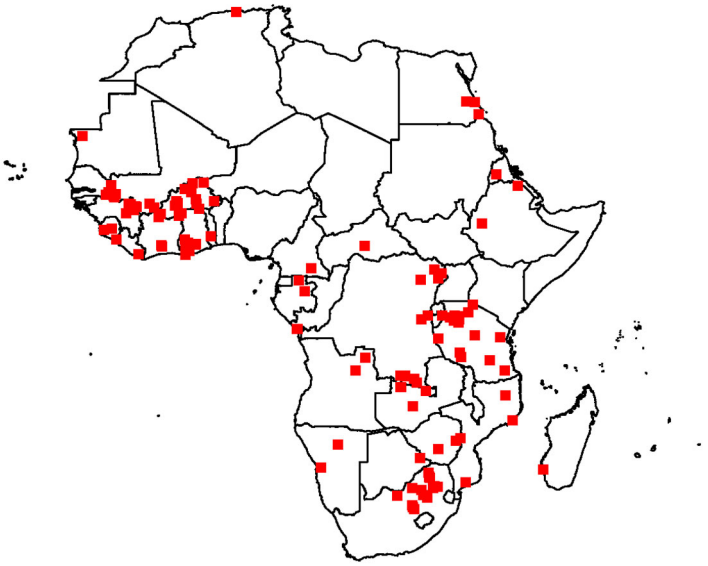
did not have such luxury and had to reduce economic activity.[9] Urban informal economic activities that could be the dominant sources of livelihoods for the poor are likely to be severely affected by the pandemic, dampening activities in more urbanized regions. Therefore, the net impact of the pandemic on regional inequality is ambiguous.

BOX 2: DISCOVERY OF MINERALS AS A PROXY FOR INVESTMENT

In the absence of data on investment at subnational level, increased investments following the discovery of minerals, that is, elevated investment from mineral discovery to production was relied on to substitute for the missing data. During 1992 to 2012, there were 117 mineral discoveries in sub-Saharan Africa. Figure 2.1 shows the locations of these discoveries. There is a time-lag between a discovery and the beginning of production, during which the companies proceed with substantial investments in the region where the mineral is discovered.

Empirical estimates suggest a time lag of four to six years between discovery and production in the case of giant discoveries (Arezki and others 2017). Since not all discoveries are giant, a time lag of one to four years was considered. As a result of this time lag, the evidence shows that the impact is limited to the period of investment after the discovery. When the production starts and the country becomes an exporter, inequalities could increase, as revenues from exports are spent in major urban centers or can flow out of the country.

Figure 2.1. Sub-Saharan Africa: Mineral Discoveries During 1992–2012



Sources: Minex Consulting's mineral deposit database; and IMF staff calculations.
Note: Minex gathers the occurrences of discoveries of extractive minerals such as gold, copper, nickel, etc. in sub-Saharan Africa between 1992 to 2012.

[9] Compared to other regions of the world, the necessary preconditions for remote work do not seem to be satisfied in sub-Saharan African countries and likely less so in poor regions of these countries.

BOX 3: COUNTRY CASE STUDY OF SOUTH AFRICA AND ETHIOPIA

This box analyzes trends of regional and intraregional inequality in Ethiopia and South Africa, and sheds light on some national policies implemented to reduce regional inequality.

South Africa has large regional and intraregional inequality compared to Ethiopia. When we compare consumption per capita, South Africa has persistent higher regional inequality from 2004 to 2015 (Figure 3.1). While Ethiopia initially had lower regional inequality, it has been increasing in recent years from its low base. Intraregional inequality also presents stark differences between the two countries. Comparing regions with the lowest to the highest regional inequality in both countries, South Africa has systemically higher intraregional inequality than Ethiopia (Figure.3.2). These observations suggest that the combined high regional inequality and intraregional disparities among households reflect the higher overall inequality in South Africa. The leading-lagging region gap in South Africa is quite high. Western Cape and Gauteng, where economic activity is concentrated in and around Cape Town and Johannesburg, are leading regions. Eastern Cape, KwaZulu-Natal, and Limpopo appear to have been left behind. Similarly, in Ethiopia the mostly urban regions of Addis Ababa and Harari are leading regions. However, the divide between these leading regions and the lagging Afar and Somali regions is not as wide as the ones observed in South Africa.

Historical factors, differences in levels of development, infrastructure, and policies and strategies pursued by the governments might explain the various levels and trajectories of inequality. Until recently, Ethiopia's development strategies have been focused on agriculture, which, in turn, is argued to facilitate industrial development (Carnia and Martorano 2017). Under the recent Growth and Transformation Plans, more emphasis is placed on structural transformation to support inclusive growth. In addition, pro-poor public spending on health, education, infrastructure, water, and sanitation have played a crucial role (Carnia and Martorano 2017; World Bank 2020). In South Africa, since the end of apartheid, the government has taken several measures to address inequality and poverty, including the use of fiscal spending for redistribution. The first post-apartheid measures can be traced back to the 1993 Reconstruction and Development Program, including the social wage. The social wage refers to the government's investment in education, health services, social security, public transport, and housing, and has played a key role in the effort to decrease inequality and poverty (World Bank 2018). More recently, other policies have been adopted to continue the government's effort to eradicate poverty and reduce inequality. The most recent being the National Development Plan 2030, which—in addition to poverty and inequality—identifies unemployment as one of the major challenges the country faces (World Bank 2018). The two countries also differ significantly in the level of infrastructure development, including transport and electricity. The 2020 Africa Infrastructure Development Index (AIDI), which ranges from 0 to 100, puts South Africa (with AIDI of 79) farther ahead of Ethiopia, which had an index of 10.[10]

Figure 3.1. Trends of Regional Inequality in Ethiopia and South Africa

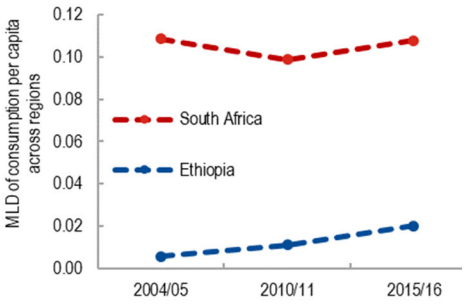
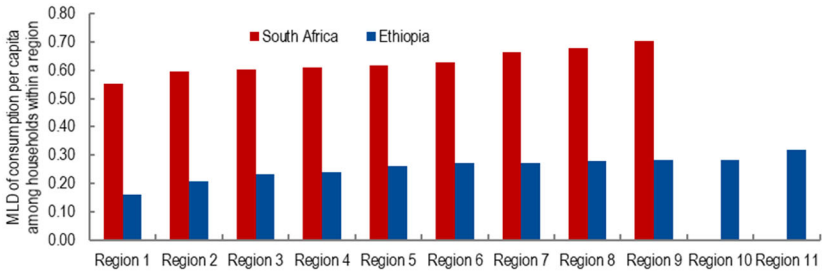


Figure 3.2. Trends in Intraregional Inequality in Ethiopia and South Africa



Sources: Household budget surveys from the National Statistics Offices; and IMF staff calculations.
Note: These results are based on the latest available household surveys (2015 for Ethiopia and 2014 for South Africa). Regions are ranked from lowest to highest intraregional inequality. The region numbers are as follows: Ethiopia:1 = Somali, 2 = Oromia, 3 = Addis Ababa, 4 = SNNP, 5 = Amahara, 6 = Harari, 7 = Benshangul Gumuz, 8 = Afara, 9 = Tigray, 10 = Gambella, 11 = Dire Dawa; and South Africa: 1 = Northern Cape, 2 = North West, 3 = Free State, 4 = Mpumalanga, 5 = KwaZulu-Natal, 6 = Limpopo, 7 = Gauteng, 8 = Western Cape, 9 = Eastern Cape.

[10] AIDI is compiled by the African Development Bank.

Analytical Note Annex

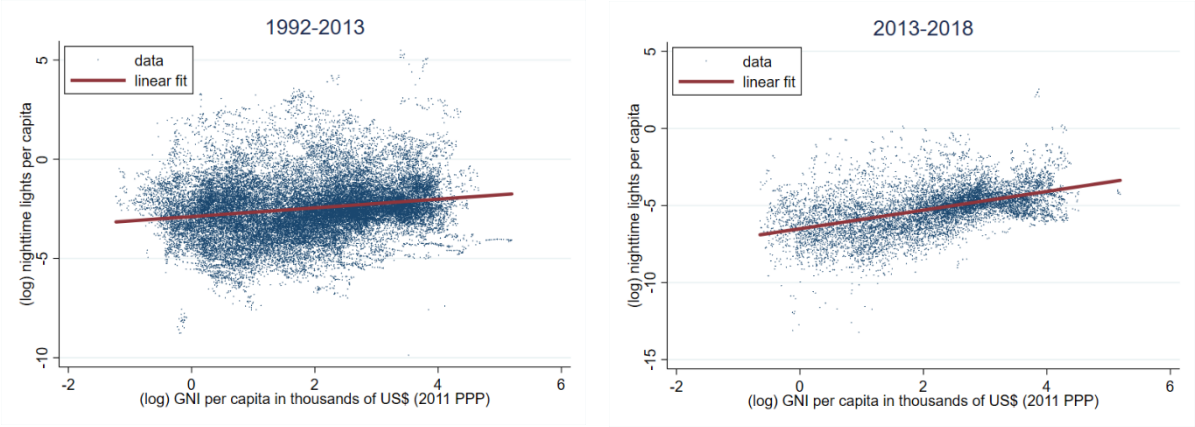
ANNEX 1. NIGHTTIME LIGHTS AND ECONOMIC ACTIVITY AT SUBNATIONAL LEVEL

Since the seminal work of Chen and Nordhaus (2011) and Henderson, Storeygard, and Weil (2012), satellite-recorded nighttime light (NTL) data have been used extensively as a proxy for economic activity. Their spatial granularity and global coverage make them particularly useful for understanding subnational economic activity, for which official data is typically not available.

This note leverages NTLs at the district level to construct regional inequality indicators. A crucial assumption is that NTLs are a linear proxy of economic activity. Although the linear relationship between NTLs and economic growth is well established at the national level (see, for example, recent work by Hu and Yao (2021), and Beyer, Hu, and Yao (2022)), their relationship at the subnational level is understudied. To examine this, we use the Subnational Human Development Database (Smits and Permanyer 2019) from the Global Data Lab (GDL), which contains rough estimates of gross national income (GNI) per capita for subnational regions. Using the same geographic boundary (shapefiles), NTLs per capita of those subnational regions were constructed and compared with the corresponding estimate of GNI per capita.

The results presented in Figure Annex 1.2 show that there is a broadly linear relationship between NTLs and GNI per capita, both for the early version of satellite data that covers the period 1992–2013 (left panel) and for the recent version that spans from 2013 to 2018 (right panel).[1] However, there is considerable noise around the linear fit. Several factors are behind the regional differences in NTLs at similar levels of GNI per capita. First, subnational GNI per capita is a rough approximation of a region's economic activity, as it incorporates income received from outside the region. In addition, NTLs contain considerable noise due to atmospheric conditions at different locations of the world and the nature of some economic activities like agriculture makes them harder to capture using NTL. It is therefore not surprising that the relationship between NTLs and GNI per capita is only approximately linear. However, to the extent that those differences are persistent, they do not affect the evolution of regional inequality, because they only affect the levels of inequality but not the trends. As such, NTLs can be used as a reliable proxy.

Figure Annex 1.2. NTLs Per Capita and GNI Per Capita at the Subnational Level.



Sources: Global Data Lab; Earth Observation Group, Payne Institute for Public Policy, Colorado School of Mines; and IMF staff calculations.
Note: Both nightlight per capita and GNI per capita are in logarithmic term. PPP = purchasing power parity.

[1] Nighttime lights data are available to the present while subnational GNI per capita data are only available up to 2018.

ANNEX 2. MEASURING REGIONAL INEQUALITY

Throughout this analysis, mean-log deviation (MLD) is used as a measure of regional inequality. MLD is widely used in the inequality literature (Ravallion 2019). Unlike the Gini index, MLD is additively decomposable by population subgroups. For example, it allows researchers to decompose a country's (nightlight-based) overall regional inequality in economic activity into two: (1) within-province inequality across its districts; and (2) inequality between provinces of the country. The sum of within-province and between provinces inequalities is used as an indicator of regional inequality in economic activity throughout this Regional Economic Outlook analytical note.

Let $y_{i,j,t}$ be the economic activity in district j of province i at time t. Let m be the average economic activity in a location (region, district or national) and p be the corresponding population. The overall regional inequality of a country can be decomposed as follows,

$$MLD_t = \sum_i \sum_j \frac{\ln \frac{m_t}{y_{i,j,t}}}{p_t}$$

$$= \sum_i \frac{p_{i,t}}{p_t} \sum_j \frac{\ln \frac{m_{i,t}}{y_{i,j,t}}}{p_{i,t}} + \sum_i \frac{p_{i,t}}{p_t} \ln \frac{m_t}{m_{i,t}}$$

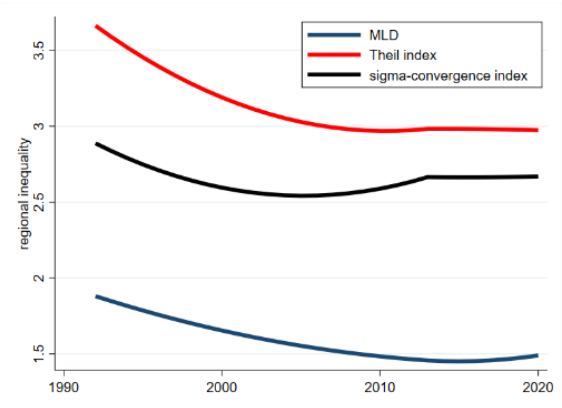
$$= \sum_i \frac{p_{i,t}}{p_t} \sum_j \frac{p_{j,t}}{p_{i,t}} \ln \frac{m_{i,t}}{m_{i,j,t}} + \sum_i \frac{p_{i,t}}{p_t} \ln \frac{m_t}{m_{i,t}}$$

$$= within\ province + between\ province$$

With nightlights per capita as a proxy for economic activity at the district level ($y_{i,j,t} = m_{i,j,t}$), the within-province inequality is expressed as $MLD_t^{wp} = \sum_i \frac{p_{i,t}}{p_t} \sum_j \frac{p_{j,t}}{p_{i,t}} \ln \frac{m_{i,t}}{m_{i,j,t}}$ and between-province inequality as $MLD_t^{bp} = \sum_i \frac{p_{i,t}}{p_t} \ln \frac{m_t}{m_{i,t}}$. Based on the additive nature of MLD, the overall regional inequality is defined as the sum of within-province and between-province inequality: $MLD_t = MLD_t^{bp} + MLD_t^{wp}$.[1,2]

Alternative measures of inequality are also prevalent in the literature. For instance, Theil index is an inequality measure that is decomposable into within and between group inequality. While the MLD is sensitive to changes at the bottom of the income distribution, the Theil Index is sensitive to changes at the top. The standard deviation of income is another measure of inequality, which is often used to describe sigma-convergence, although it is not decomposable into subgroups. Figure Annex 2.1 compares the estimated trend of region inequality within countries for SSA and shows that the patterns are broadly similar.

Figure Annex 2.1. Alternative measures of regional inequality of economic activity within countries in sub-Saharan Africa



Sources: Earth Observations Group, Colorado School of Mines; and IMF staff calculations.

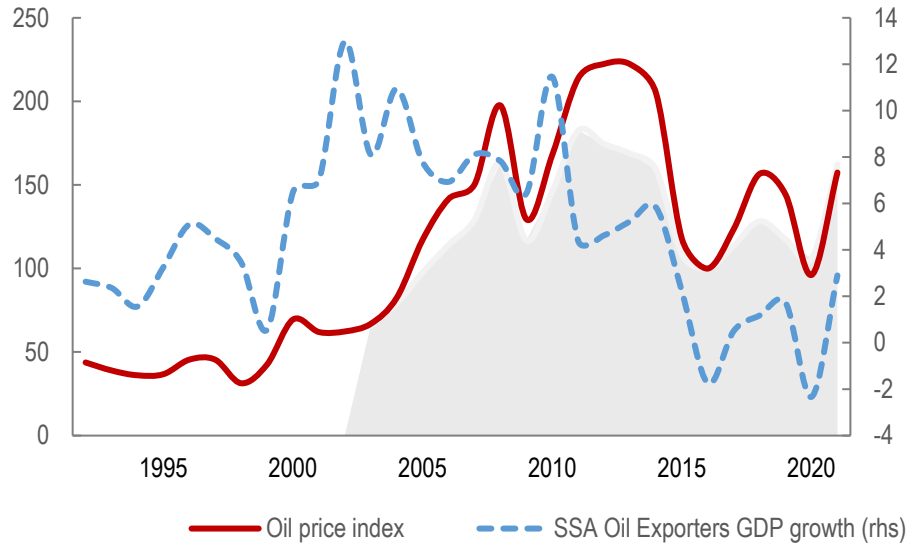
[1] For consumption per capita data from household surveys, individual-level consumption was observed and hence within province inequality is defined as inequality among individuals, instead of inequality between districts.

[2] Other measures of regional inequality were investigated, including the sample variance of log income or Theil-L index (Theil 1967). They typically show the same trend of regional inequality as the MLD.

ANNEX 3. FIGURES AND TABLES

Figure Annex 3.1. Global Commodity Index and GDP Growth of Sub-Saharan Africa Oil Exporters

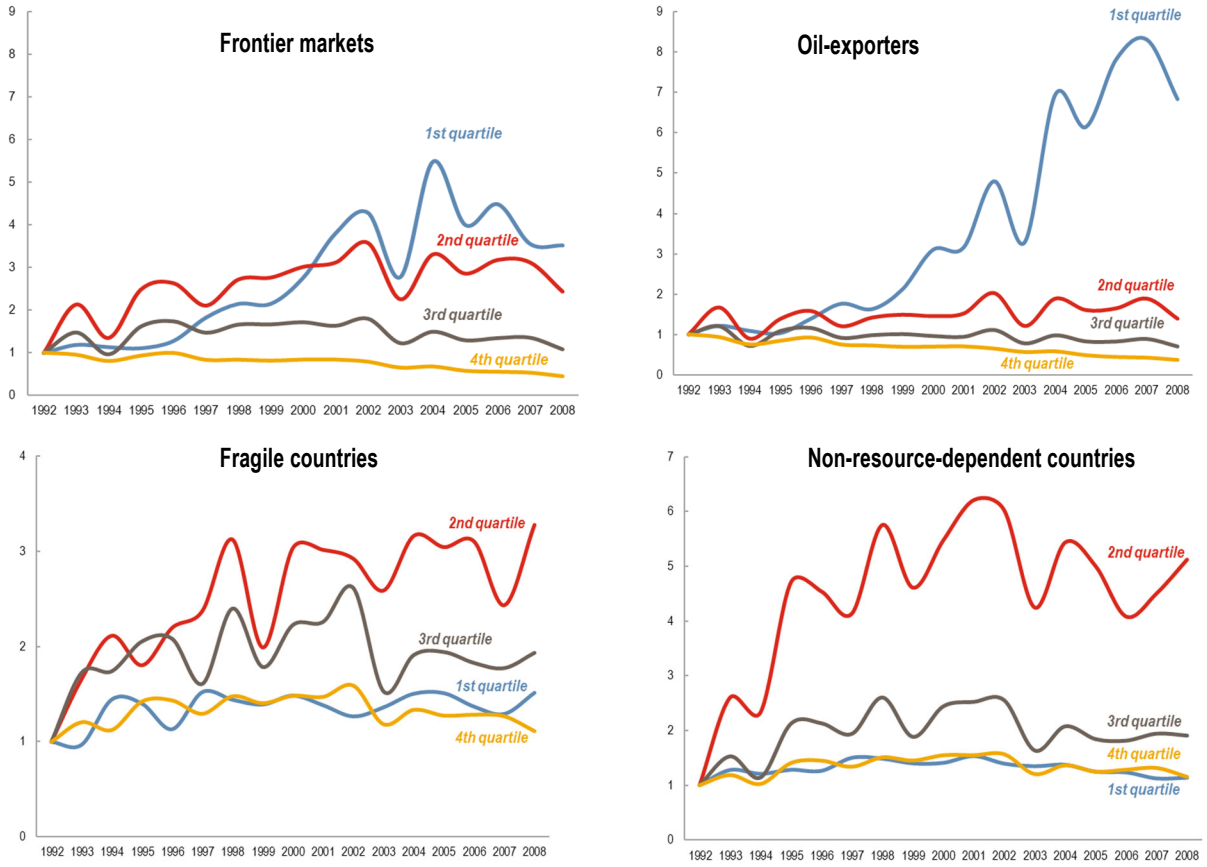
Sub-Saharan African oil exporters enjoyed a rapid growth in the commodity boom of 1990s and 2000s…



Sources: IMF, World Economic Outlook database; Primary Commodity Price System.
Note: Commodity prices are indexed to 2016. "All commodities" includes fuel and non-fuel commodities. "Oil index" is APSP crude oil (US$ per barrel). SSA = Sub-Saharan Africa.

Figure Annex 3.2. Growth in NTLs Per Capita of the Poorest and Richest Regions in Sub-Saharan African Frontier Markets and Oil-Exporters

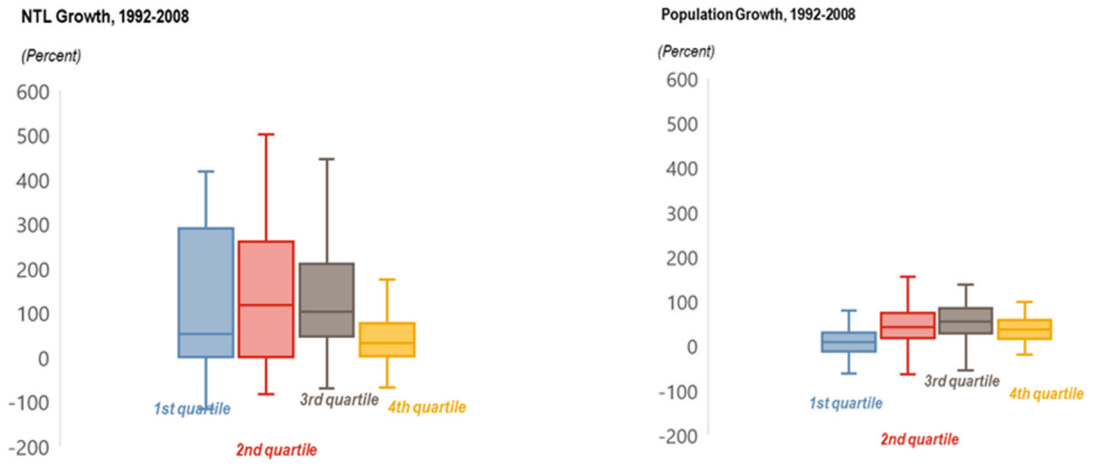
Faster improvements in NTLs per capita in the lagging regions contributed to the rapid convergence…



Sources: Earth Observations Group, Colorado School of Mines; and IMF staff calculations.
Note: First quartile refers to the poorest region and fourth quartile refers to the richest region.

Figure Annex 3.3. Growth of NTL and Population

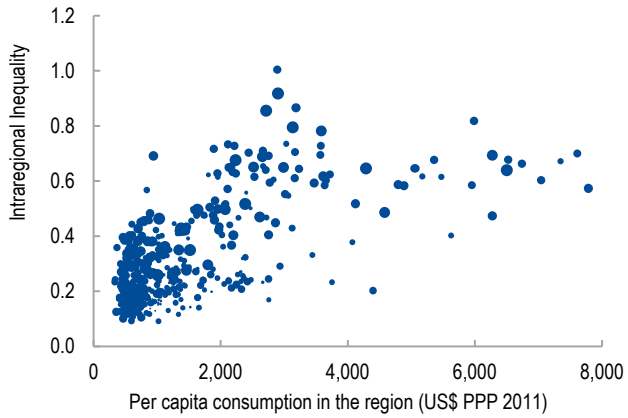
…faster NTL growth contributed to the faster convergence than the change in population.



Sources: Earth Observations Group, Colorado School of Mines; and IMF staff calculations.

Figure Annex 3.4. Intraregional Inequality and Consumption Level

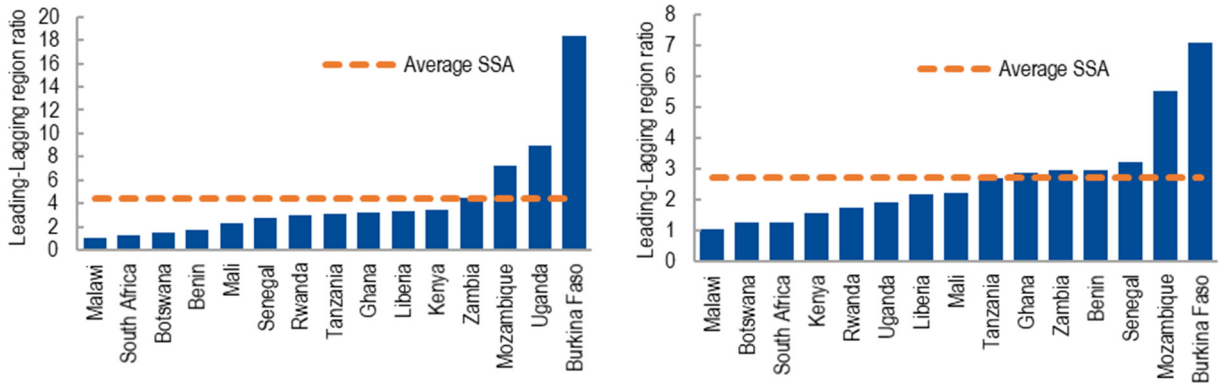
... and intraregional inequality increases with income levels



Sources: Household budget surveys from the National Statistics Offices; and IMF staff calculations.
Note: PPP = purchasing power parity.

Figure Annex 3.5. Gaps in Access to Electricity and in Secondary Education

...larger regional disparities in some countries than in others.



Sources: Earth Observations Group, Colorado School of Mines; IPUMS; World Bank; and IMF staff calculations.
Note: SSA = Sub-Saharan Africa.

Table Annex 3.1. Determinants of Regional Inequality

	(1)	(2)	(3)	(4)
Inflation, t-1	0.6599***	0.7303***	0.7158***	0.7077***
	(0.115)	(0.068)	(0.061)	(0.069)
GDP per capita, Log, t-1	0.0000	-0.0813	-0.0724	-0.0622
	(0.148)	(0.289)	(0.243)	(0.331)
Trade openness, t-1	-0.1098	-0.0958***	-0.0935***	-0.0949**
	(0.156)	(0.030)	(0.028)	(0.037)
Terms of trade, t-1	-0.0999	-0.0713	-0.0689	0.0202
	(0.099)	(0.070)	(0.068)	(0.040)
Civil war, t-1	0.1699	0.2693**	0.2589**	0.2990**
	(0.560)	(0.127)	(0.119)	(0.125)
Regulatory quality, t-1	-0.2215	-0.2740***	-0.2688***	-0.2207***
	(0.311)	(0.086)	(0.083)	(0.072)
GDP growth, t-1	0.0009	0.0020	0.0015	0.0045
	(0.007)	(0.003)	(0.003)	(0.003)
Urbanization rate, t-1			0.1873	
			(0.395)	
Discovery, t-3				-0.0448**
				(0.019)
Constant	0.4300	1.0301	1.2549	0.9125
	(1.185)	(2.297)	(2.374)	(2.644)
Observations	288	288	288	260
Number of countries	27	27	27	26
R-squared	0.162	0.897	0.901	0.914
Country fixed effects	No	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes

Robust standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1

Sources: Earth Observations Group, Colorado School of Mines; World Economic Outlook; World Bank, World Development Indicators and Worldwide Governance Indicators; Uppsala Conflict Data Program; and IMF staff calculations.
Note: The analysis covers 27 sub-Saharan African countries during the 1992–2013 period. The dependent variable is regional inequality, proxied by MLD of nightlight per capita. The correlates do not vary across regions within each country. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

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