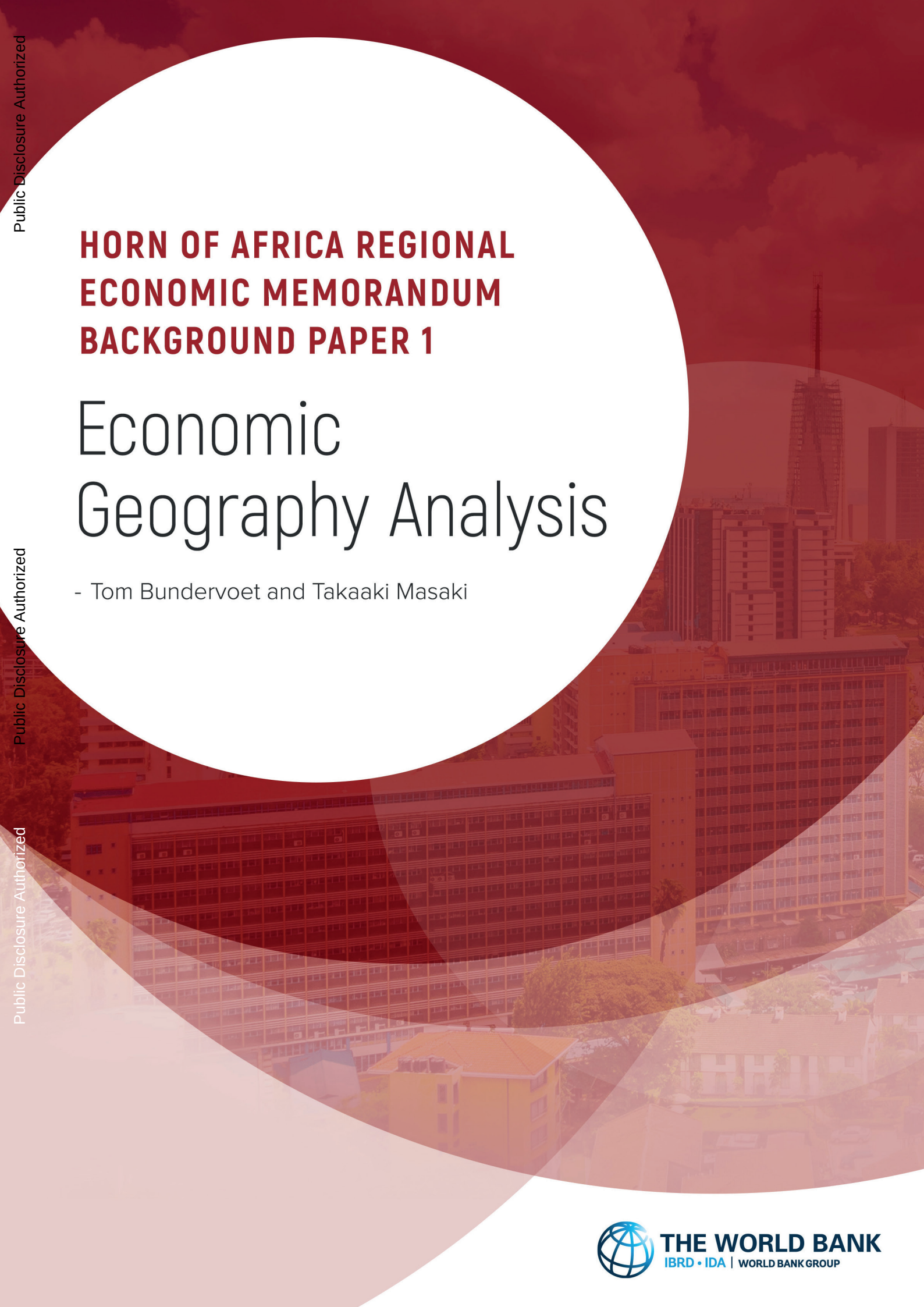
HORN OF AFRICA REGIONAL ECONOMIC MEMORANDUM BACKGROUND PAPER 1

Economic Geography Analysis

- Tom Bundervoet and Takaaki Masaki



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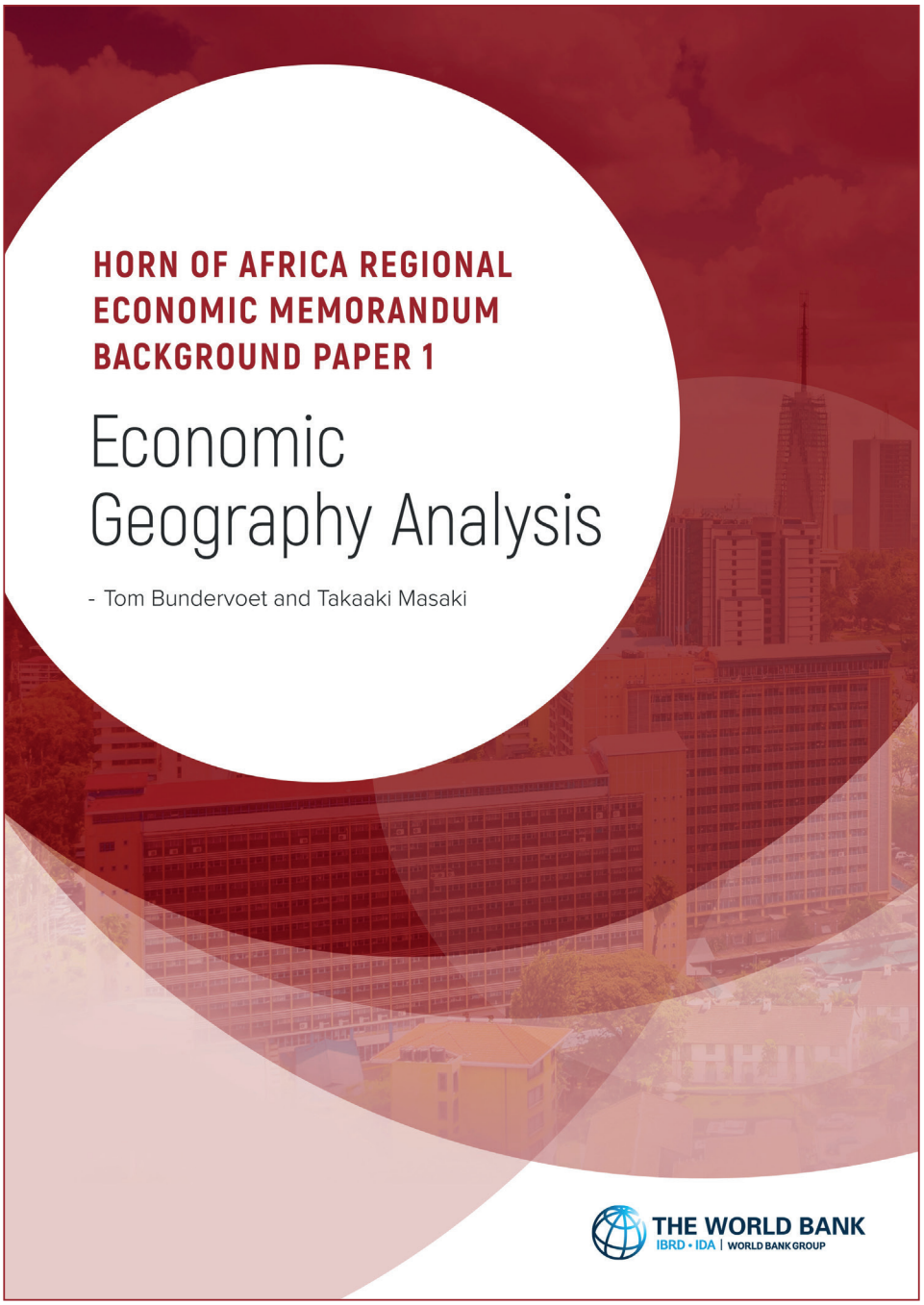


CONTENTS

The Horn of Africa (HoA) is most commonly known for its long history of strife, fragility, droughts, and seemingly intractable conflicts. A complex set of historical, ideological, political, economic, geographical, territorial, and environmental factors have created tensions within and between states, at times boiling over into inter- and intra-state violent conflicts. These conflicts have, in turn, further weakened states' capacity to provide public services, social cohesion, and further increased the vulnerability of its population and the risk of future conflicts. Climate change is now exacerbating an already difficult situation, leading to increased tension over natural resources. Successive shocks of different kinds have led to record numbers of displaced people[1] and increased migration, mostly irregular, to Gulf countries.[2]

Yet the true picture of the HoA is more nuanced, with the HoA including Africa's fastest-growing economy (Ethiopia) and East Africa's most advanced economy (Kenya). Despite all the challenges, real progress has been made in recent years. Per capita GDP levels in the HoA increased at an average annual rate of almost four percent between 2013 and 2018 and the share of the population living below the US$1.9 a day poverty line declined from 40 percent in 2005 to 33 percent 10 years later.[3] Gains were made on non-monetary dimensions of welfare as well, with the four HoA countries for which data are available increasing their Human Development Indices.[4]

This background note analyzes the economic geography of the Horn of Africa using the framework of the 2009 Word Development Report.[5] For the purpose of this report, the Horn of Africa (henceforth HoA) comprises of five countries: Djibouti, Eritrea, Ethiopia, Kenya and Somalia.[6] This note first seeks to provide a descriptive snapshot of recent socio-economic trends in the HoA countries vis-à-vis the regional trends in sub-Sahara Africa (SSA) as a whole. Second, it sheds light on the economic geography of the HoA region with a particular focus on 3D (density, distance, and division).[7] In particular, this note highlights that borderlands of the HoA countries suffer from a combination of low density and high distance that hinders the borderlands from tapping their full economic potential. It finally concludes with a set of policy recommendations for removing barriers to sustainable growth in the region.

1 In 2019, there were an estimated 4.3 million IDPs in the HoA, divided between Somalia and Ethiopia.

2 In 2018, over 315,000 migration movements were observed between the HoA and the so-called Eastern Route (towards Yemen and the Arabian Peninsula), increasing to 469,000 in 2019 (DTM, 2019; https://ronairobi.iom.int/sites/default/files/document/publications/2019_DTMRegionalSnapshot_EHoA_2019.pdf.

3 Based on PovCalNet and WDI. Only includes Kenya, Ethiopia and Djibouti. There are no consistent data on Somalia and Eritrea, whose combined population accounts for nine percent of total population in HoA.

4 http://hdr.undp.org/en/composite/HDI. No data for Somalia.

5 World Bank, 2009.

6 These five countries decided, on October 18, 2019, to forge closer economic ties by fostering economic integration and regional cooperation in the HoA.

7 This 3D analytical framework is borrowed from WDR2009. *Density* refers to the economic mass per unit of land area, or the geographic compactness of economic activity. It is shorthand for the level of output produced—and thus the income generated—per unit of land area. It can, for example, be measured as the value added or gross domestic product (GDP) generated per square kilometer of land. Second, *distance* refers to the ease or difficulty for goods, services, labor, capital, information, and ideas to traverse space. It measures how easily capital flows, labor moves, goods are transported, and services are delivered between two locations. Distance, in this sense, is an economic concept, not just a physical one. Lastly, *division*, by contrast, refers to any restrictions on the mobility of people, goods and services due to border restrictions, territorial disputes, civil wars, and conflicts between regions and countries, among others.

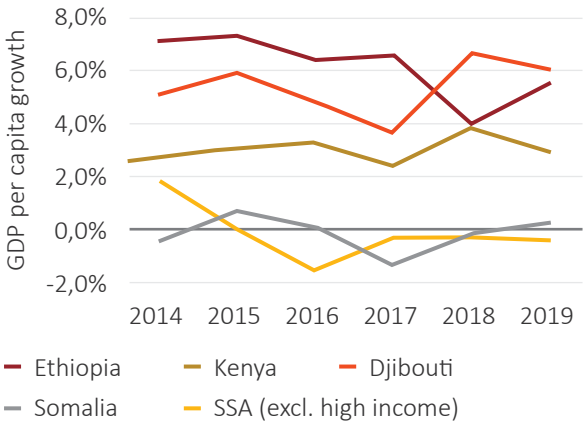
SECTION 1

Introduction: Positive Recent Trends, Mostly from a Low Base

Between 2014 and 2018, growth in the HoA outpaced growth in SSA as a whole. While real per capita GDP levels remained essentially flat in SSA (excluding high income), they grew at an annual rate of four percent in the HoA[8] (Figure 1). Ethiopia, Djibouti and Kenya recorded the highest per capita growth rates, while in Somalia economic growth hardly outpaced estimated population growth. Despite the recent positive trends, income levels in the Horn remain below the SSA average. Average GDP per capita of the four HoA countries amounted to about US$1,000 in 2018, compared to US$1,600 for SSA (excluding high income). There is substantial variation within the HoA itself, with per capita income levels being almost 10 times higher in Djibouti than in Somalia (Figure 2).

Figure 1: Economic growth in the HoA was solid

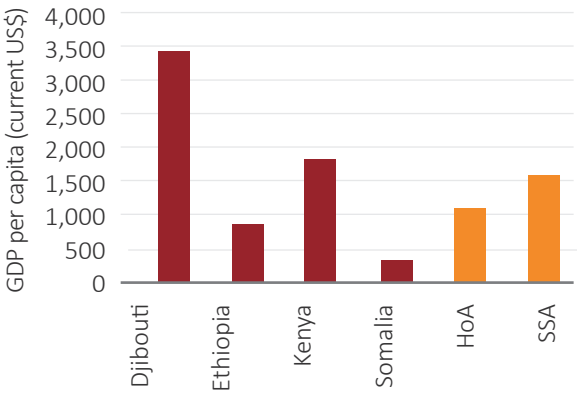
(Per capita GDP growth, 2014-2018))



Source: WDI, 2020; Somalia Economic Update, 2020. World Bank staff calculations.

Figure 2: Income levels remain low in comparison

(Per capita GDP levels, 2018, current US$)



Source: WDI, 2020. Somalia Economic Update, 2020. World Bank staff calculations.

Though trends in poverty have been positive too, the pace of poverty reduction has been too weak to reduce the number of poor people. For the three countries where data are available, poverty rates saw a modest decline from 40 percent around 2005 to 33 percent around 2015,[9] while the absolute number of people living in poverty rose by 9 percent over the same period. Poverty rates range from 17 percent in Djibouti to 69 percent in Somalia (Figure 3).[10] Overall, an estimated 57 million people across the HoA live below the poverty line (Figure 4).

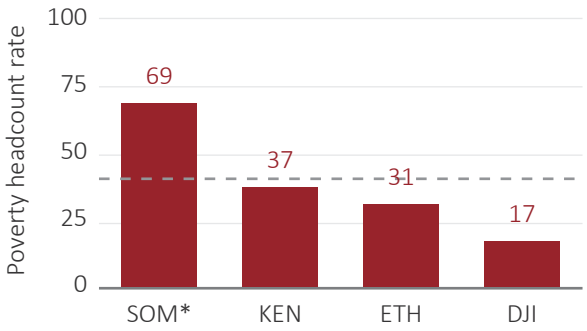
8 This does not include Eritrea where there are no publicly available and reliable GDP data.

9 For Ethiopia, poverty surveys were conducted in 2004/5 and 2015/16. For Kenya, 2005/6 and 2015/16. For Djibouti, 2002 and 2017. Poverty is measures based on the international US$1.9 poverty line.

10 Somalia's poverty rate is estimated based on areas that were safe enough to survey. It does not include areas which were inaccessible due to insecurity.

Figure 3: One third of the population lives below US$1.9 a day

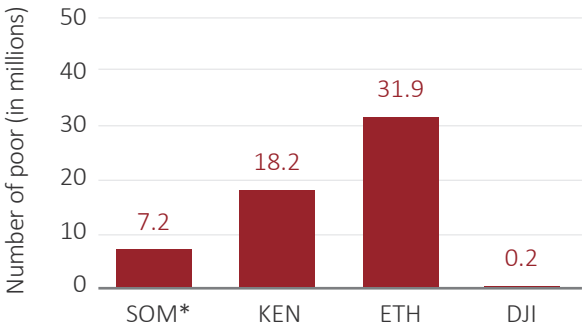
(US$1.9 a day poverty rate)



Source: World Bank staff calculations based on the latest survey available (2017 for Djibouti, 2015 for Kenya, 2015/16 for Ethiopia, and 2017/18 for Somalia). The dash line corresponds to the regional poverty headcount rate for the HoA (except Eritrea).
Notes: * indicates that Somalia's poverty rate is estimated based on areas that were safe enough to survey. It does not include areas which were inaccessible due to insecurity.

Figure 4: Ethiopia and Kenya account for the bulk of the poor

(Estimated number of people below US$1.9, millions)

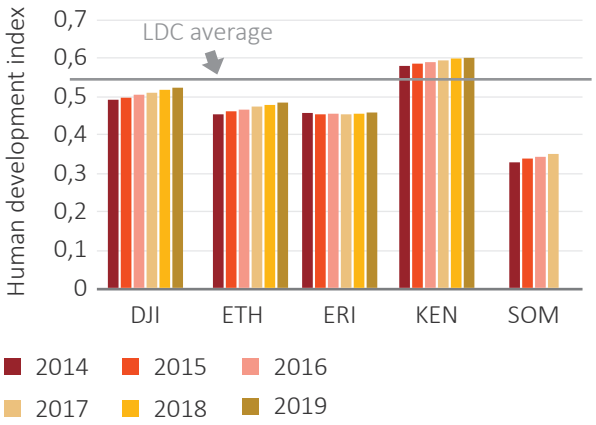


Source: World Bank staff calculations based on the latest survey available (2017 for Djibouti, 2015 for Kenya, 2015/16 for Ethiopia, and 2017/18 for Somalia).

Human development outcomes improved in line with economic growth but still remain low. Between 2014 and 2018, the Human Development Index (HDI), a summary measure of average achievements in health, education, and living standards, improved in all countries except for Eritrea (Figure 5). With the exception of Kenya, the HDI remains however below the Least Developed Countries' average. Education outcomes remain particularly poor, even among the younger generation. Between half and two-thirds of children finish primary school (except for Kenya, where completion is universal) and gross enrolment in secondary school remains relatively low (Figure 6). Based on the most recent household living standards surveys, 45 percent of youngsters between 15 and 24 had completed primary school or more at the time of the survey (between 2015 and 2017, depending on the country).

Figure 5: Human development improved

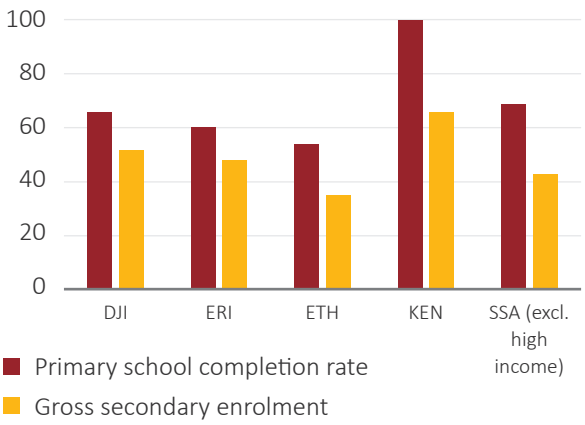
(Human Development Index, 2014-2018)



Source: UNDP, 2020.

Figure 6: But education outcomes generally remain weak

(Primary completion rate and gross secondary enrolment)

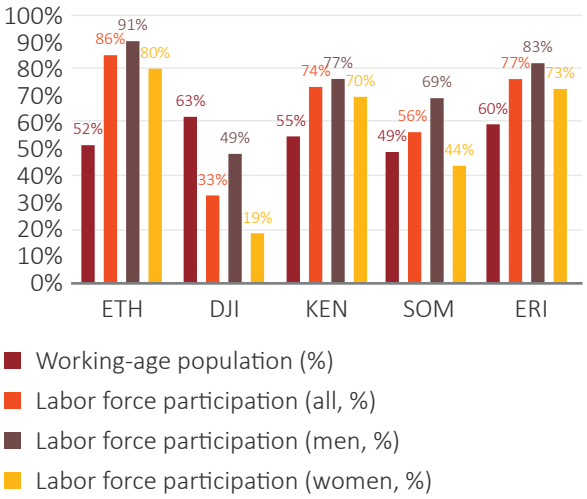


Source: WDI, 2020. KNBS, 2018.

Labor market outcomes differ across countries but remain relatively poor, especially for youth and women. In countries where the population is predominantly agricultural, labor force participation rates are high. High labor force participation is an empirical regularity in largely agrarian low or lower middle-income countries and reflect the high prevalence of unpaid family labor and the need to work in absence of robust social assistance systems rather than strong labor demand. In Ethiopia, Eritrea and Kenya, labor force participation rate reaches 86 percent, 77 percent, and 74, respectively (Figure 7). In Djibouti and Somalia, labor force participation is low, mainly driven by cultural and social norms regarding the labor market participation of women. Youths' participation in the labor market is low particularly in Djibouti, Kenya and Somali (Figure 8). For Djibouti and Kenya though, this is partly explained by the high share of young people who are in school.

Figure 7: Labor force participation is high except for Djibouti and Somalia

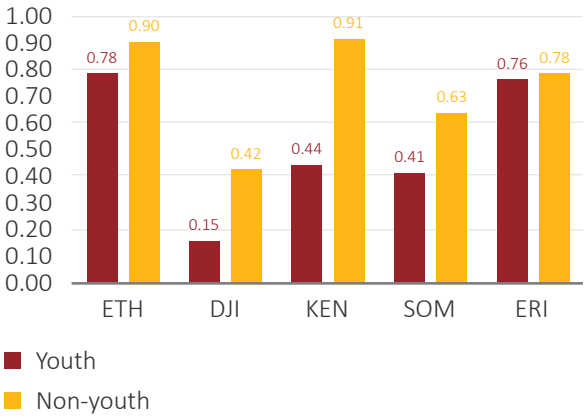
(Labor force participation rate, %)



Sources: 2013 LFS for Ethiopia, 2017 household survey for Djibouti (GMD database), 2015 KIHBS for Kenya, 2017 HFS Wave 2 for Somalia, and 2015/16 LFS for Eritrea.

Figure 8: Youth are generally less likely to participate in the labor force

(Labor force participation rate, %)

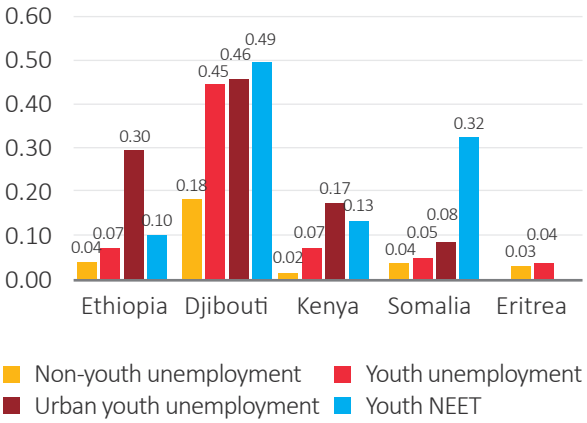


Sources: 2013 LFS for Ethiopia, 2017 household survey for Djibouti (GMD database), 2015 KIHBS for Kenya, 2017 HFS Wave 2 for Somalia, and 2015/16 LFS for Eritrea.

A considerable share of youth across the HoA are Not in Employment, Education, or Training (NEET) (Figure 9). A young person who is NEET is not engaged in any productive activity or any activity that can increase his/her productivity in the future (e.g. education), which represents a waste of human resources. As a result, NEET is often considered a measure of exclusion from productive activities. Young women are particular at risk of being NEET. Open unemployment is relatively low in the HoA (except for Djibouti) (Figure 10). Once again, this does not reflect a strong labor market though rather the rural nature of most countries in the HoA and the need for people to work in absence of public social assistance systems. Unemployment is significantly higher in urban areas, especially among youth: in Ethiopia, in Kenya and in Djibouti.

Figure 9: Youth NEET is substantial across the HoA

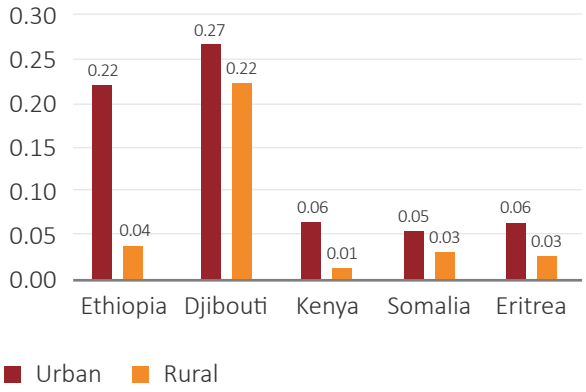
(Share of youth 15-29 Not in Employment, Education or Training)



Sources: 2013 LFS for Ethiopia, 2017 HBS for Djibouti (GMD database), 2015 KIHBS for Kenya, 2017 HFS Wave 2 for Somalia, and 2015/16 LFS for Eritrea.

Figure 10: Though unemployment rates are fairly low

(Unemployment rate, %)



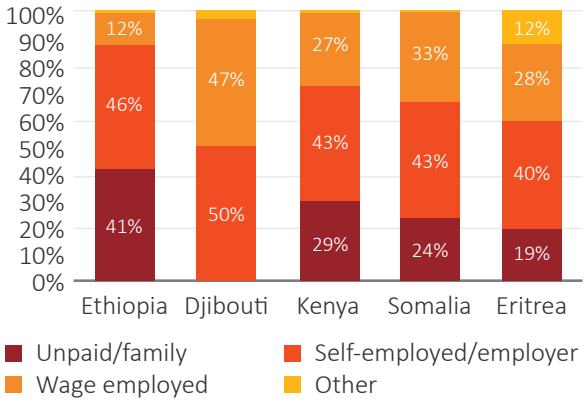
Sources: 2013 LFS for Ethiopia, 2017 HBS for Djibouti (GMD database), 2015 KIHBS for Kenya, 2017 HFS Wave 2 for Somalia, and 2015/16 LFS for Eritrea.

Employment is dominated by self-employment and agriculture, though there are substantial variations across countries. Self-employment and unpaid family work dominate employment in all the HoA countries except for Djibouti, which has a higher rate of wage employment though this number may be over-reported (Figure 11).[11] The incidence of wage employment is also closely related to the sectoral composition of employment (Figure 12). In Ethiopia, where agriculture accounts for the bulk of employment, wage employment is particularly rare. In countries with a larger employment share in services, wage employment is more common, though even in the services sector self-employment tends to be at least as important as wage employment. There are few differences in the sector of employment between youth and older adults, but youth are much more likely to work as unpaid family labor.

[11] The survey data used for Djibouti records no unpaid work at all and it is likely that such employment is instead mistakenly coded as self-employment, wage employment, or perhaps, as inactivity. Thus, the numbers for Djibouti need to be treated with caution.

Figure 11: Self-employment and unpaid work account for the bulk of employment in the HoA

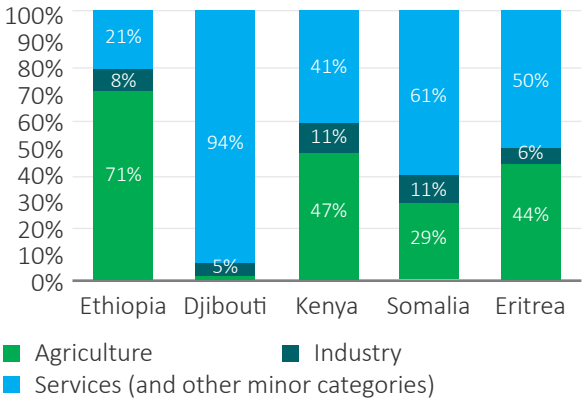
(Share of employment type in overall employment)



Sources: 2013 LFS for Ethiopia, 2017 HBS for Djibouti (GMD database), 2015 KIHBS for Kenya, 2017 HFS Wave 2 for Somalia, and 2015/16 LFS for Eritrea.

Figure 12: Agriculture and services dominate employment in the HoA

(Sectoral composition of employment)



Sources: 2013 LFS for Ethiopia, 2017 HBS for Djibouti (GMD database), 2015 KIHBS for Kenya, 2017 HFS Wave 2 for Somalia, and 2015/16 LFS for Eritrea.

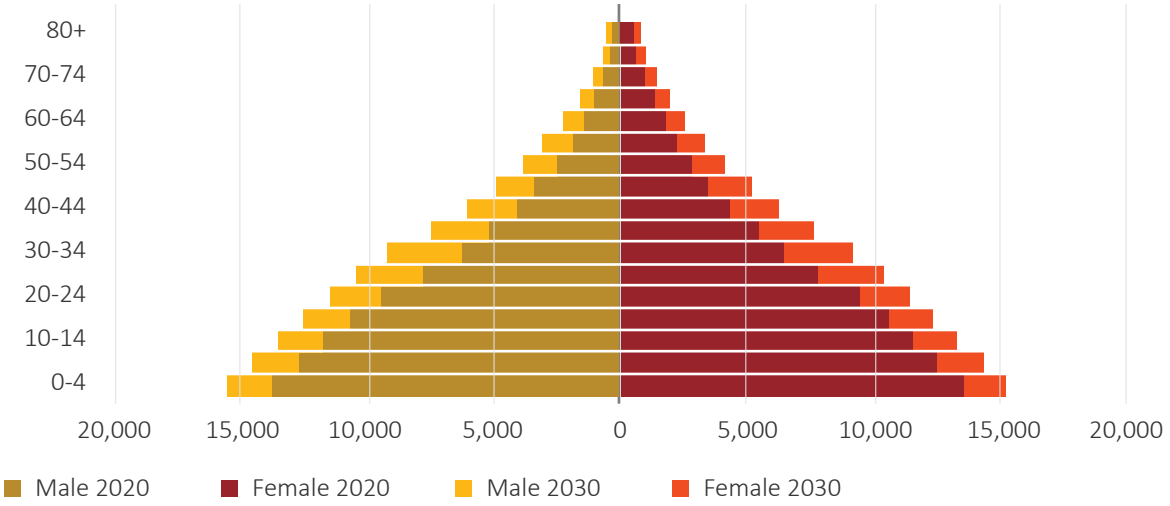
The employment challenge in the HoA is compounded by its rapidly growing population. The working-age population in the HoA is projected to grow from 107 million in 2020 to 143 million by 2030, leading to a spike in demand for jobs and economic opportunities. While a rapidly growing working age population can be a boon for growth through the so-called demographic dividend, fertility declines in the HoA have so far been too slow to lead to rapid shifts in the projected age-structure of the population. While the share of the working-age population is projected to increase from 57 percent in 2020 to 60 percent by 2030, each successive age cohort will still remain bigger than the previous one, meaning that a HoA-wide demographic dividend is not around the corner (Figure 13).[12] Lowering fertility rates and strengthening the institutions necessary to realize the demographic dividend should be a priority for the HoA,[13] along with generating productive employment opportunities for a burgeoning and relatively poorly-educated labor force.

12 A common misperception is that a large and growing youth population itself is an indicator of a coming demographic dividend. It is not. The first step is a transition from high birth and death rates to low birth and death rates (Population Reference Bureau, 2012). This transition, especially the one to low birth rates, has been slow.

13 Many scholars acknowledge the ineffectiveness of the demographic transition in realizing the demographic dividend if quality institutions are not in place. These institutions include basic health care and schooling, infrastructure, rule of law and efficiency of the bureaucracy, etc. (Lee, Lee and Mason, 2006; Bloom, Canning and Sevilla, 2003).

Figure 13: The demographic transition is still incipient in the HoA

(Population pyramid of the HoA, 2020 and 2030)



Source: WPP, 2019. WB staff calculations.

SECTION 2

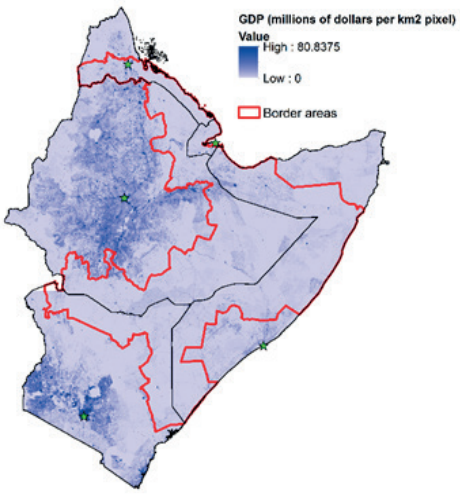
Economic Geography of the HoA: Density, Distance, and Division

2.1 Density: Spatial Distribution of Economic Activity and Living Standards

Population density and economic density are closely linked. The economic density map (Figure 14) largely mirrors the population density map (Figure 15).[14] In Ethiopia, close to 90 percent of the population live in the highlands, despite the highlands accounting for less than half of Ethiopia's territory (World Bank, 2019). In Kenya, 20 percent of counties – which are densely populated and concentrated spatially in the southwestern part of the country – account for over 40 percent of population[15] while in Eritrea, it is estimated that the top 10 most populated districts, which are located mostly in the northeast, the country's capital, account for around 40 percent of population.[16] In Somalia, high densities of population are observed in Mogadishu, Kismayo, Baidoa and Hargeysa and along major road networks that are connected to these major cities.

Figure 14: Economic production in the HoA is highly concentrated

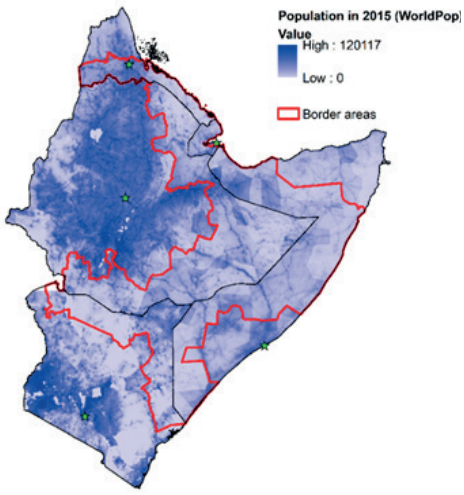
(Estimate of GDP per squared kilometer, 2006)



Sources: Ghosh et al. (2010).

Figure 15: Population is concentrated in economically-dense areas

(Estimated population distribution, 2015)



Sources: WorldPop.

14 Our regression analysis suggests that population densities alone account for about half of the variation in economic densities (See Appendix A-1).

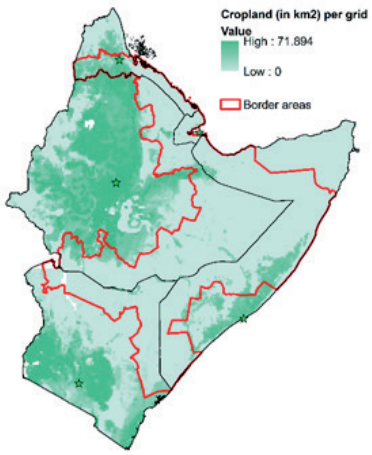
15 Out of 47 counties, the most populated 10 accounted for 41 percent of the population in the 2019 population census.

16 The World Bank's estimates based on population data from WorldPop and GADM ADM2 shapefile.

Economic activities in the HoA are also spatially concentrated particularly in areas that are characterized by high market accessibility and agricultural productivity. Those areas that are proximate to or better connected to large urban population centers tend to attract much of the regional economic activities – a topic that is discussed more extensively in the following section on distance.[17] This is particularly visibly discernible in and around Addis Ababa where the higher densities of economic activities are observed along the major corridors stretching from or into the city. Furthermore, in countries with a substantial agricultural base (Ethiopia, Kenya and, to a lesser extent, Eritrea), economic densities tend to be higher in places that are largely characterized as agrarian (or dominated by croplands): The central highlands of Ethiopia crossing north into Eritrea towards Asmara and crossing east into Somalia towards Hargeisa, and the area around Nairobi and stretching westwards towards Kisumu and the shores of Lake Victoria (Figure 16). It is also in these agricultural breadbaskets that the countries' biggest cities are located. In Djibouti and Somalia, both arid and hot countries, economic activity is concentrated in places with a comparative advantage for trade through seaports: Djibouti city in Djibouti and Mogadishu (and to a lesser extent Kismayo) in Somalia.

Figure 16: Economic density also largely reflects cropland availability

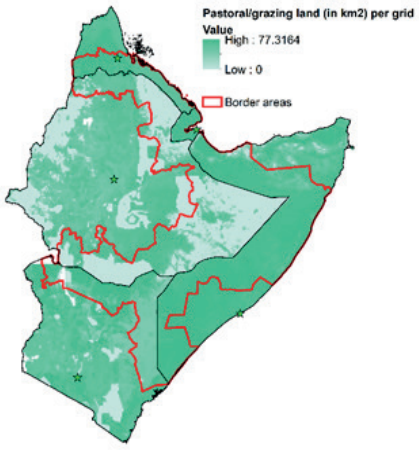
(Cropland in km² per 5 arc minutes cell 2010)



Source: HYDE 3.2.

Figure 17: Low economic densities in border areas where predominant way of living is pastoral

(Pastoral/grazing land in km² per 5 arc minutes cell 2010)



Source: HYDE3.2.

The vast and sparsely populated border areas are a salient feature of the HoA. The HoA border areas,[18] demarcated by the red lines in Figure 14, account for over 44 percent of the combined territory of the five countries but make up only 13 percent of total population and 9 percent of economic output. A larger swath of the borderlands is classified pastoral/grazing land (Figure 17). A large majority of people in the borderlands engage in pastoralism, agropastoralism and trade. The border areas are also where many of the Horn's challenges come

17 Our regression analysis shows that market accessibility, as defined in Box 3, is strongly and positively correlated with economic densities. Overall, market accessibility explains 14 percent of the overall variation in economic densities across the HoA.

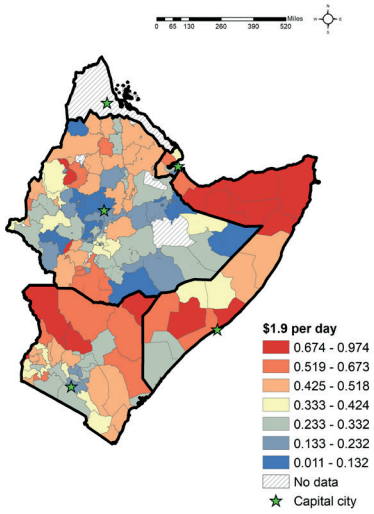
18 We defined border areas as second-order administrative divisions (ADM2) that share a land border with another country with the exception of the regions of Tigray and Djibouti which are distinctively different from the rest of the borderlands in terms of their demographic and environmental characteristics and thus excluded.

together: A legacy of economic, social, and political marginalization; poor service delivery and infrastructure; conflict, violence, and forced displacement; and environmental degradation, all spilling across national boundaries. While there are differences across countries, the reach of the state in these areas is generally weak, and informal and illicit activities flourish. Yet these border areas are bound to play a key role if trade and cooperation across the HoA is to increase and deepen, highlighting their importance in a regional integration agenda.

The spatial distribution of economic density is reflected in spatial differences in living standards. Using the US$1.9 a day poverty line, poverty rates are generally lower in the economically dense areas than in the economically-lagging ones (Figure 18).[19] There are several ways to classify economically dense (or "leading") areas vs. lagging areas. This report uses two alternative classifications, which, as will be shown below, yield qualitatively similar results. First, a simple urban vs rural dichotomy is used as a proxy for leading vs. lagging areas given the concentration of formal economic activity in urban areas. Second, we use the border area definition introduced before to define the border areas as economically-lagging areas, as evidenced by Figure 14. We find that poverty rates in rural areas of the HoA (39 percent) are close to three times higher than in urban areas (15 percent), while poverty in the border areas is 12 percentage points higher than poverty in the non-border or core areas. Using the border area definition introduced before, poverty rates in the economically-lagging border areas amounted to 44 percent, compared to 32 percent in the non-border areas. Differences in poverty between the economically dense core and the periphery (or borderlands) are high and statistically significant. That said, given the sparsely populated nature of the border areas, the density of poverty is not situated in the border areas. The bulk of the poor live in the wealthier (and hence more populated) parts of these countries (Figure 19).

Figure 18: Poverty rates tend to higher in the sparsely populated border areas

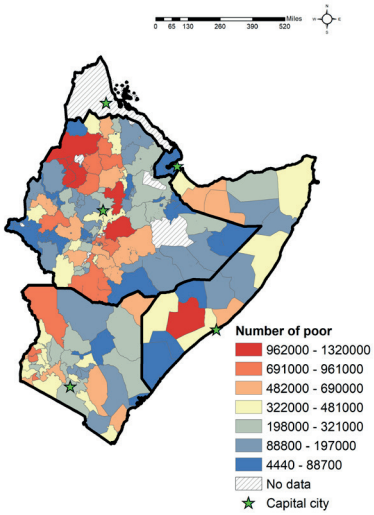
(Share of population below the US$1.9 poverty line)



Source: World Bank staff calculations using the latest household survey available in each country.

Figure 19: Though most of the poor live in the economically-dense areas

(Number of people below the US$1.9 poverty line)



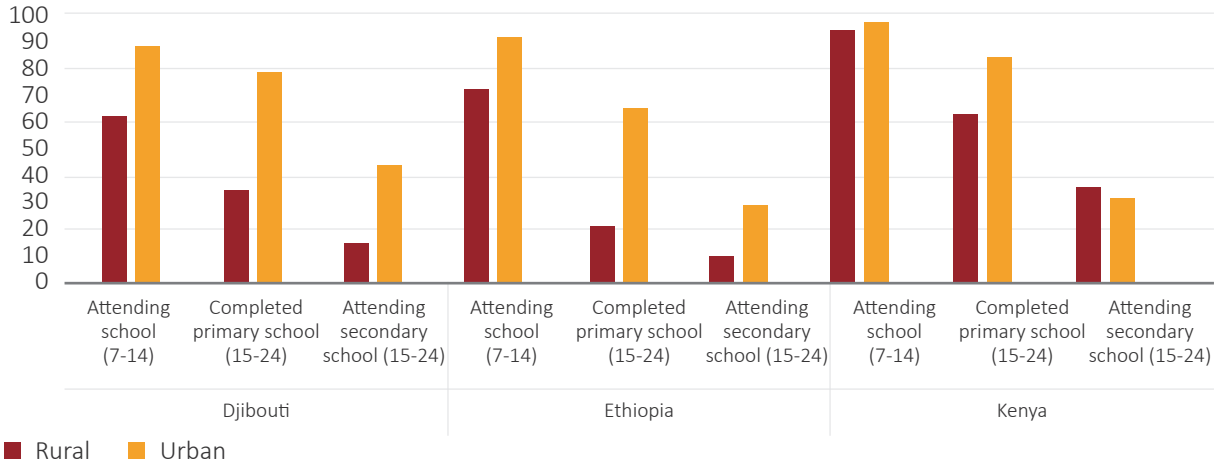
Source: World Bank staff calculations using the latest household survey available in each country.

19 Our econometric diagnostic identifies a strong negative relationship between economic densities and poverty (see Appendix A-1).

The disparity between leading and lagging areas is salient for other social indicators as well. Education indicators display large disparities between both the rural and urban areas and the border and core areas of each of three countries for which comparable data are available (Djibouti, Ethiopia, and Kenya). The share of 7-14-year-olds attending school, the share of youth aged 15-24 that have completed primary education, and the share of youth 15-24 attending secondary education are substantially lower in rural areas and in border areas for all three countries, as opposed to urban areas and core areas, respectively (Figure 20 and Figure 21). Indicators of access to health care and health outcomes also tend to be substantially worse in the economically-lagging areas, translating into subnational multi-dimensional poverty rates that are substantially higher in the border areas than in the economically dense areas (Figure 22).

Figure 20: Education outcomes lag in rural areas

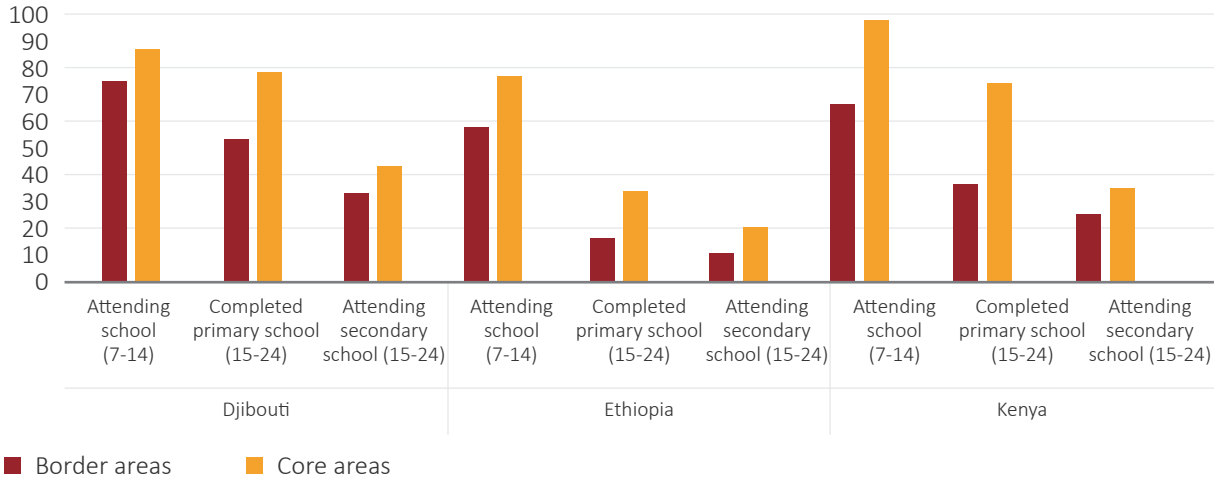
(Selected education indicators, Djibouti, Ethiopia, Kenya)



Source: GMD, 2020; World Bank staff calculations.

Figure 21: Education outcomes also lag in the border areas

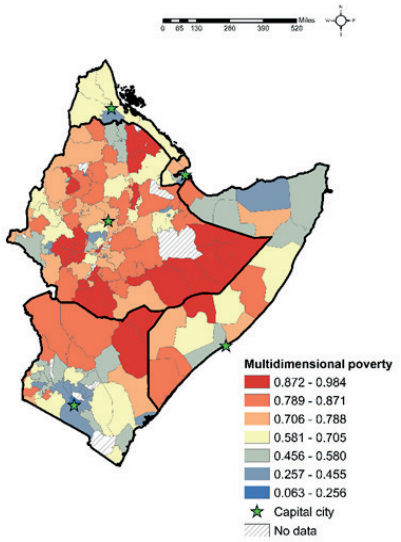
(Selected education indicators, Djibouti, Ethiopia, Kenya)



Source: GMD, 2020; World Bank staff calculations.

Figure 22: Non-monetary dimensions of poverty are most severe in the border areas

(Subnational multi-dimensional poverty rates)



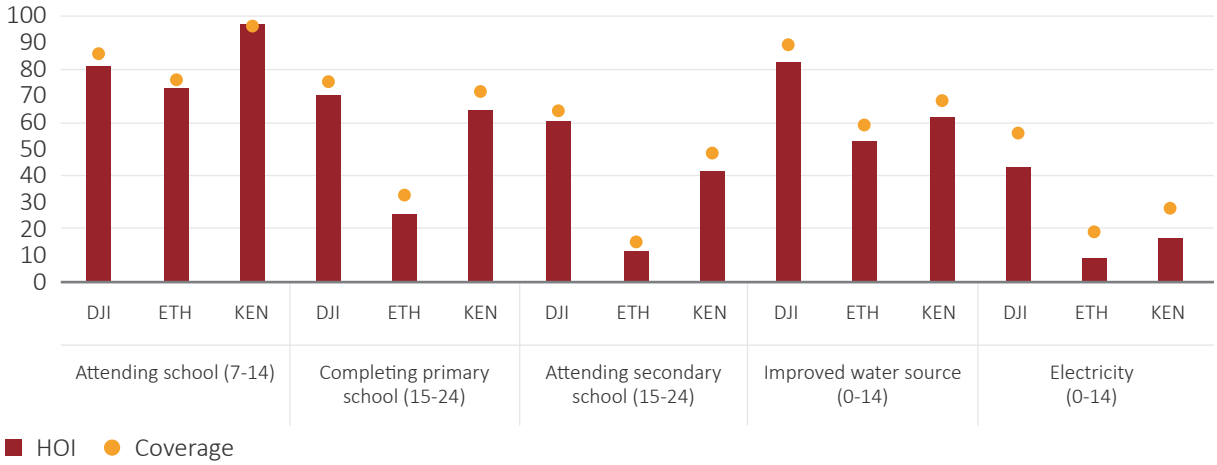
Source: World Bank staff calculations based on the latest household survey available for Djibouti (2017), Ethiopia (2015), Kenya (2015), and Somalia (2018) while the subnational estimates for Eritrea are imputed based on the subnational human development index database (Smits and Permanyer 2019). Notes: Our estimates of multidimensional poverty for Somalia based on the 2018 SHFS should be treated with caution as the survey is only representative for safe areas.

To explore in more detail the source of inequity in access to public services and opportunities in the HoA, we use the "Human Opportunity Index" (HOI) approach (Box 1). In basic terms, the HOI methodology calculates the coverage of a certain opportunity in the population (for instance, the share of children completing primary school) as well as a measure of inequality in accessing that opportunity (for instance, the share of children completing primary school can be higher in urban than in rural areas, or higher for children from better-off compared to worse-off households). The coverage rate is then corrected by this inequality measure to arrive at the HOI for that opportunity. The larger the difference between the coverage rate and the HOI, the larger the inequity across groups for the specific opportunity.

Access to most basic opportunities in the HoA is low and uneven. The exception is school attendance for young children (defined as 7-14-years-old), which is generally high and equally distributed (small differences between the coverage rate and the HOI), reflecting solid progress in extending basic education to larger segments of the population (Figure 23). Completing primary school and attending secondary however remain lower, especially in Ethiopia, and is much more unequal. Inequity is highest for electricity access, where the HOI is substantially lower than the coverage rate in all three countries.

Figure 23: Significant gaps in coverage of basic opportunities in the HoA

(Coverage rate and human opportunity index, Djibouti, Ethiopia, Kenya)

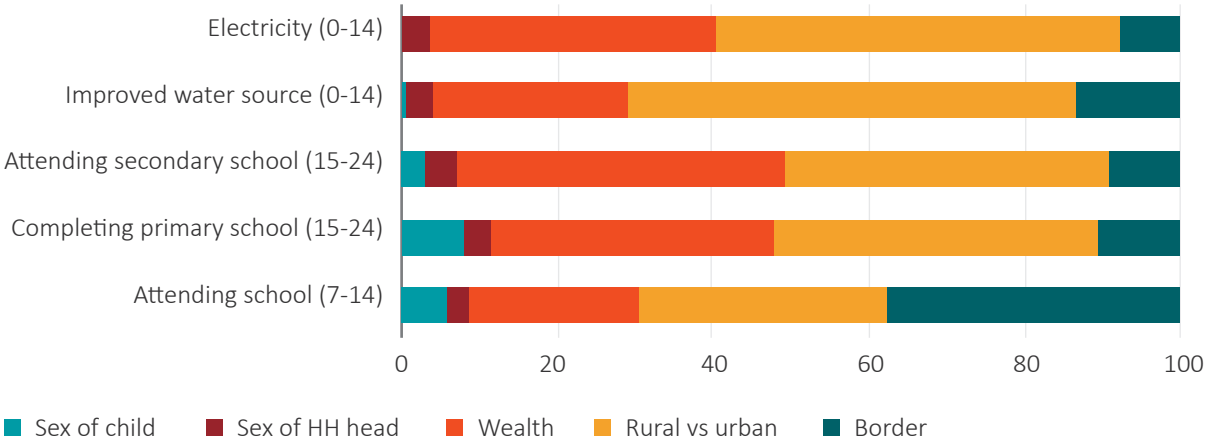


Source: World Bank staff calculations on the countries' most recent poverty surveys.

Location and wealth shape access to opportunities in the HoA. Decomposing the inequality in access to opportunities into contributions by different circumstances shows that the location and welfare levels of the household a child is born into determines to a significant extent of the child's access to opportunities.[20] To illustrate, 42 percent of the inequity in primary school completion can be attributed to rural vs urban location and 37 percent to differences in household welfare levels (as proxied by quintiles of per capita household consumption expenditures - Figure 24). Similarly, rural vs urban location accounts for 58 percent of the inequity in access to an improved drinking water source, with differences in household welfare explaining another 25 percent. While urban vs. rural location emerges as the main source of spatial inequity in access to important basic services, being located in a border area adds to the rural disadvantage. For instance, living in a border area is the main predictor of whether a young child attends school.

Figure 24: Location and wealth shape access to opportunities

(Contribution to inequity in access to a given opportunity, Djibouti, Ethiopia, Kenya)



Source: World Bank staff calculations on countries' latest poverty surveys.

Box 1: The Human Opportunity Index

The Human Opportunity Index (HOI) is widely used to measure inequality of opportunity. The HOI captures both (i) the overall access to basic services, such as education, water and electricity (the coverage rate); and (ii) inequality in access (Barros, Ferreira et al. (2008)). If access to a basic service is perfectly equal, then the HOI is the same as the coverage rate. As access becomes more and more unequal, so the HOI becomes lower and lower.

The extent of inequality of opportunity is measured using the D-index (the dissimilarity index). This index calculates how much access to services varies by birth characteristics, such as socio-economic status of a households and the location of the household. A D-index of zero indicates perfect equality (no gaps

[20] "Circumstances" are variables that are outside the control of a child but nevertheless affect his/her opportunities in life. Five circumstances are considered in the analysis: Location of the household (binary variables for rural or urban and being located in a border area), gender of child, gender of the household head, and the household's consumption quintile.

in access to services across circumstance groups), whereas a D-index of one indicates perfect inequality

The central question behind the HOI is to what extent circumstances beyond one's control influence one's access to a set of important basic services. Simply put, the HOI takes the coverage level of a basic service or "opportunity" (for example whether a child is enrolled in primary education) and combines this with the extent to which that opportunity is determined to be beyond the control of the child (for example being born in a rural rather than urban area or being a girl rather than a boy). Ideally, random circumstances should play no role in determining access to opportunities.

The D-index measures dissimilar access rates to a given basic opportunity for groups of children where groups are defined by circumstance characteristics (for example, area of residence, or gender) compared to the average access rate to the same service for the population as a whole. To formulate groups the sample is stratified into groups or "cells," so that all individuals in any given cell have the same combination of circumstances. The resulting subgroups are known in the literature as "types" (Barros, Ferreira et al. (2008)). These cells are then compared to one another. The difference in outcomes between cells can be attributed to inequality of opportunity, while the differences within cells can be considered the result of effort or luck.

The D-index summarizes all the gaps into a single measure by weighting them according to the population share in each circumstance group. The D-index generates a value between 0 and 1. In a society in which there is no inequality of access the D-index is be zero. If average access is denoted by $\bar{p}$, the specific access rate of group i is p_i, and the share of group i in the population is given by β_i then the D-index is:

$$D = \frac{1}{2\bar{p}} \sum_{i=1}^{n} \beta_i | p_i - \bar{p} |$$

The HOI can then be calculated as:

$$HOI = \bar{p}(1 - D)$$

The measure is also decomposable so that the extent to which specific opportunity sets contribute to the dissimilarity can be assessed. This means that the contribution of different circumstances to overall inequality of opportunity can be determined.

To summarize, economic activity in the HoA is concentrated in areas with better agricultural potential, high market access, and in large cities with high population densities. Living standards and access to public services tend to be better in the economically-dense leading areas, with monetary and non-monetary dimensions of welfare being substantially worse in areas with lower economic density. Location and wealth shape access to opportunities in the HoA, with urban vs. rural location being the main spatial source of inequity in access to important opportunities and border area location conferring an additional disadvantage.

The spatial concentration of economic activity in the HoA is by no means exceptional. Economic activity is highly spatially concentrated in almost every country in the world, even in today's highly-developed nations. Nor is the concentration of economic activity accidental: Economic activity tends to concentrate in places favored by market forces. The co-incidence of economic density and better living standards have led many policy-makers around the globe to try to push economic activity to lagging regions with the aim of spurring economic development and improved living standards in those regions. These efforts have in most cases failed or come at a high cost to the public purse. Rather, improved living standards in lagging regions can come about through better integrating the economies of the leading and lagging regions through reducing the economic distance. This is the topic of the next section.

2.2 Distance: Access to Markets and Lagging Areas

The previous section looked at the spatial concentration of economic activity in the HoA and the disparities in living standards between economically-dense and economically-thin areas. This section focuses on the second important geographic dimension: Distance. While it is normal for economic activity to concentrate in certain favored places, the distance to these places will largely determine whether other, less-favored, places benefit from the dense economic activity as well. Distance here does not refer to physical distance, but to the ease or difficulty for goods, services, labor, and capital to move between the leading places and the other places. It measures how easily capital flows, labor moves, goods are transported, and services are delivered between two locations. Distance here is an economic concept, not just a physical one.

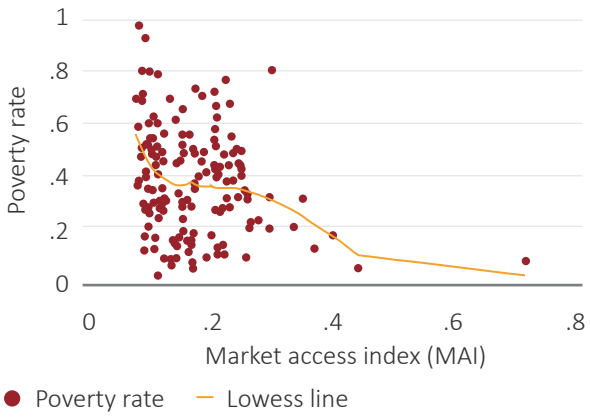
Higher distance to density tends to be correlated with worse social and economic outcomes. The farther from density, the more likely an area is to be lagging because of its lack of integration in the economy of the leading areas. This is often reflected in poverty rates being higher in remote and poorly connected parts of a country. The HoA is no different. Market Access Index (MAI) – an indicator of economic distance (see Box 2 for further details)– is strongly correlated with poverty rates. Places with better market access have lower poverty rates and vice versa (Figure 25). Rural areas in the Horn that are better connected, as measured by the Rural Accessibility Index (RAI) or share of people living with 2km away from all-season roads (see Box 2 for further details), also experience higher increases in the density of economic activities (as proxied by nighttime light luminosity) than places that are poorly connected (Figure 26).[21]

Seen through the lens of density and distance, lagging areas are defined as places with low economic density and high distance to density. Taking together their lack of economic activity (Figure 14) and low levels of market access (Figure 27), it is clear that the border areas of the HoA classify as lagging areas. Overall, market access in the border areas is significantly worse than in other parts of the countries. Only about 27 percent of the rural population in the borderlands live less than 2km away from all-season roads, whereas this percentage jumps to about 52 percent in the non-border areas.

[21] The results from a simple bivariate quintile regression yields a positive correlation between annual nighttime light growth and RAI that is statistically significant at the 0.01 level. In this analysis, annual nighttime light growth is calculated based on changes in the mean of nighttime light for the second-administrative areas, instead of its sum. We prefer to use mean of nighttime light as a proxy for growth in economic densities because using sum would implicitly favor larger ADM2 areas with greater margins of growth by virtue of simply having larger areas (see Bruederle and Hodler 2018). If the sum of nighttime light is used, we still find a statistically significant positive relationship ($p<0.01$). However, it is worth noting that changes in nighttime light, while used extensively in the literature as a proxy for growth, may not necessarily be an accurate or precise proxy for increases in economic activities or consumption per se (Asher et al. 2021). Thus our findings should be treated with caution.

Figure 25: Distance to density is strongly correlated with poverty in the HoA

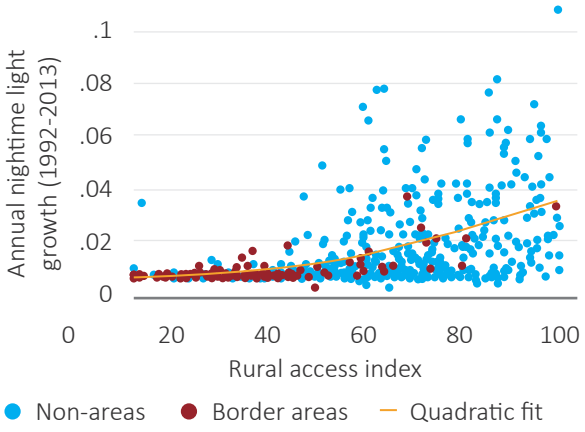
(Estimated relation between the market access index and poverty rates)



Source: World Bank staff calculations based on countries' latest poverty surveys for subnational poverty rates. The unit of analysis here is the mixture of the first- and second-administrative areas at which the latest household survey was representative.

Figure 26: Better rural access is correlated with faster growth in economic activities

(Estimated relation between the rural accessibility index and changes in economic activities at the subnational level)



Sources: Nighttime light growth based on Li et al.'s (2020) intercalibrated nighttime light data. See Box 3 for sources of data used to construct RAI. The unit of analysis here is the second-level administrative areas (ADM2) based on GADM shapefiles.

The overall level of market access varies significantly within each country in the region. Kenya performs relatively well both in terms of the MAI and RAI compared to the other HoA countries (with about 64 percent of rural people living within less than 2km away from all-season roads). However, market access appears to be lower in the northern counties than in the economically-dense belt between Nairobi and Mombasa. In Ethiopia, market access is high around Addis Ababa and in the central highlands, but poor in the peripheral parts of the country. Market access in Somalia, Djibouti and Eritrea is generally low, expect for the areas surrounding their national capitals. In several countries in the HoA, the border areas are explicitly considered as lagging regions in national programs and development plans.

Box 2: Market Access Index and Rural Access Index

The Market Access Index (MAI) captures the relative size of market capacity weighted by the degree of transportation costs. More formally, the index is constructed based on the following formula:

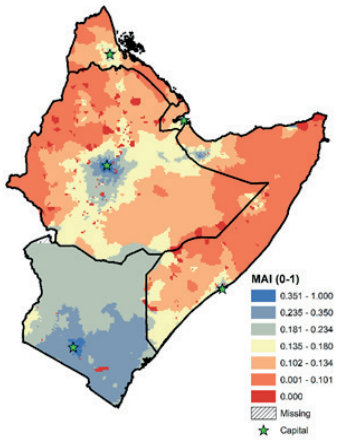
$$MAI_i = \frac{\sum_k^{\cdot} m_k / d_{ik}}{\max_i (MAI_i)}$$

where m_k refers to the size of market capacity for major city k, and d_{ik} refers to estimated transportation costs from pixel i to large city k. The weighted sum of the size of market capacity is normalized as it is divided by the maximum value of the market access index across all pixels; thus, the final index ranges from 0 to 1. In other words, what this index measures is how easy it is to access major markets from pixel i relative to other locations.

The Rural Access Index (RAI) measures the share of rural population living within 2km away from all-season roads. To construct this index, we rely on three sources of data: OpenStreetMap, WorldPop 2015 population estimates, and GRUMP Global Rural-Urban Mapping Project, Version 1 (GRUMPv1) (CIESIN, Columbia University, CUNY, CIDR, IFPRI, and CIAT 2017). We apply the following methodology as laid out in https://rai.azavea.com/:

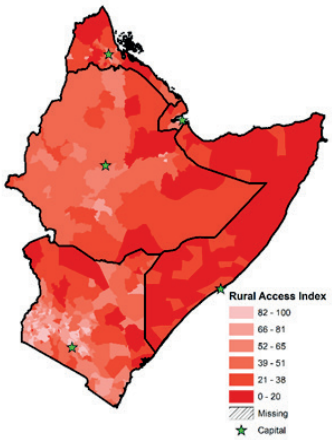
- Select commonly used tags from OpenStreetMap (Trunk, Primary, Secondary, Tertiary) that serve as an approximation for all-season roads
- Create a mask based on 2 km buffer on these roads
- Create a mask based on urban areas as defined by GRUMP urban extents polygons
- Summarize the population remaining on the 100 metre raster dataset from WorldPop 2015.

Figure 27: Market access index



Sources: World Bank (2019).

Figure 28: Rural access index



Sources: World Bank staff calculation based on OpenStreetMap and WorldPop (2015 population estimates).

Low market access in the border areas is a function of both underdeveloped transport infrastructure and relatively few large cities that serve as local centers of demand. The density of primary roads in the borderlands is about half of that in the rest of the countries.[22] In terms of urban centers, most big cities in the HoA are located in the leading areas. There are however clusters of cities across borders, notably between Ethiopia and Eritrea and Ethiopia and Somalia, that could greatly benefit from increased integration and trade across borders (Figure 29). Such medium-size cities can potentially serve as economies catalysts and secondary hubs in driving the regional production and trade (e.g., facilitating the flow of people, trade, information, and services between other smaller or metropolitan cities).[23] Looking across all the urban agglomerations across the region, it is worth highlighting that the annual rate of growth in economic densities tends to be higher in these medium size urban agglomerations than the larger ones. Based on our analysis, those secondary or medium-size cities (with an estimated population size of 100,000-500,000) saw a faster annual rate of growth in nighttime light luminosity (6 percent) compared to smaller towns/cities (3 percent) and larger urban agglomerations (4 percent).

Figure 29: Estimated GDP of urban agglomerations in the borderlands

Source: Ghosh et al. (2010).

As countries develop, economic concentration tends to further increase, only to level off at fairly high levels of development. Though there are no regional accounts in the HoA, proxy indicators suggest that economic activity has gradually concentrated in the HoA as well. Night-time lights, a commonly-used proxy for economic production, increased faster in places that were already brighter to begin with relative to less-lit (and presumably less-developed) places, though the relationship is non-linear (Figure 30). Similar, the growth in built-up area was higher in places that were already more built-up (and presumably more developed) to begin with although again, this relationship is not linear (Figure 31).

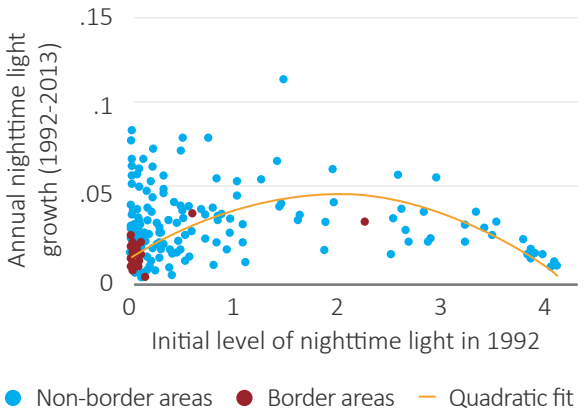
22 The World Bank calculation based on GRIP Global Roads Database (Meijer et al. 2018).

23 Roberts and Hohmann (2014).

While these indicators are proxies, they point towards people and economic activities increasingly concentrating in places that were already more developed, in terms of economic production and urbanization, to begin with. This finding accords with other studies (Henderson et al. 2018; Jedwab et al. 2017) showing that the locations of urban agglomerations remain persistent over time even after controlling for other factors that led to their establishments in the first place. These urban agglomerations continue to grow faster compared to more sparsely populated areas and have important implications for widening spatial gaps between those core cities and the rest of the countries. The border areas, marked in red in Figure 30 and Figure 31, experienced little growth in nightlights and built-up areas over the periods considered, which is in line with economic activity increasingly concentrating in the favored areas.

Figure 30: Annual rate of growth in nighttime light increased more in areas that were initially better lit

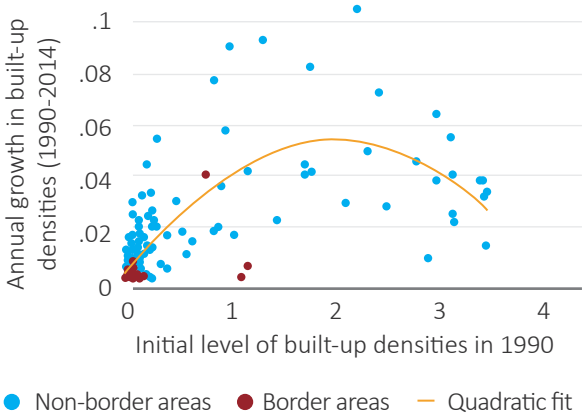
(Growth in nigh-time lights between 1992-2013 by intensity of night-time lights in 1992)



Source: World Bank staff calculations on DMSP nighttime light data. The unit of analysis is ADM2 areas based on GADM. The x-axis is the log of nighttime light plus a constant of 1 in 1992 to keep all observations.

Figure 31: Annual rate of growth in built-up area was higher in areas that were initially more built-up

(Growth in built-up densities between 1990 and 2014 by density of built-up area in 1990)



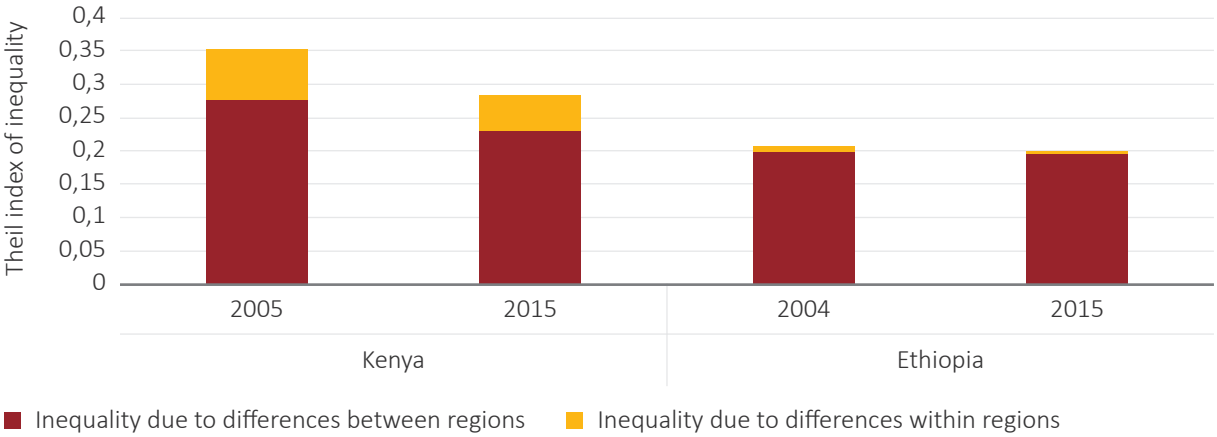
Source: World Bank staff calculations on GHS built-up dataset. The unit of analysis is based on ADM2 areas based on GADM. The x-axis is the log of building density plus a constant of 1 in 1990 to keep all observations.

Increased concentration of economic activity needs however do not necessarily coincide with increased spatial disparities in living standards. Spatial equity in living standards can improve even as economic production further concentrates. Several countries in the HoA appear to have done just that. While economic activity in Ethiopia, as proxied by night-time lights, has increasingly concentrated in the leading areas, the share of inequality in household consumption that is explained by welfare gaps between regions has decreased over time, from an already low five percent in 2004 to two percent in 2015 (Figure 32). Health and education indicators have started to converge as well but remain far lower in Ethiopia's lagging areas. In Kenya, 27 percent of the inequality in household consumption could be accounted for by gaps between provinces in 2005. By 2015, this had modestly decreased to 23 percent. These examples show that increased economic concentration and increased spatial equity in living standards can go hand-in-hand.[24]

[24] Data that allow comparisons over time are only available for Ethiopia and Kenya.

Figure 32: Gaps in household welfare between regions or provinces have become smaller

(Decomposition of the Theil index of inequality)



Source: World Bank staff calculations on countries' latest poverty surveys.

Government policies can facilitate convergence in living standards by investing in social services in lagging areas. As shown earlier, education and health outcomes in the border areas of the HoA severely lag, which is a key reason for the slow closing of the gap with the leading regions. Investing in human capital would make the labor force in the lagging areas more mobile, reducing economic distance with the leading areas through increased migration. It would also raise productivity and incomes of the future labor force in the lagging regions. In these lagging regions, investing in people is of crucial importance.

Reducing economic distance through a skills-driven increase in labor mobility and better market access will lead to a closer integration of the economies of leading and lagging areas and, over time, a decrease in spatial disparities in welfare. Whether this, by itself, will be sufficient to address the issues of lagging areas depends on the third important geographic dimension: Division. This is the topic of the next section.

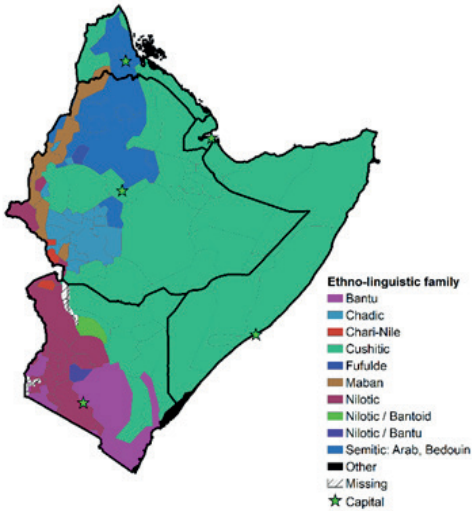
2.3 Division: Internal and External Impediments

After density and distance, the third important geographic dimension is division. Division applies at both national and international scales. At the national scale, nations can be internally divided across linguistic, ethnic, religious, and/or cultural lines. At the international level, divisions mainly arise from so-called thick borders: The many restrictions some countries impose on the flow of goods, capital, people, and ideas with other countries. Thick borders limit trade and the flow of factors of production. Interstate conflict creates the thickest borders. While borders in the rich world have become increasingly thin, hereby facilitating trade and the movement of people and capital, borders in many poor countries remain thick.

Internal and external divisions are present in the HoA. In Kenya and Ethiopia, the lagging regions are home to ethnically, religiously, and linguistically distinct populations (Figure 33 and Figure 34). That the spatial disparities coincide with different ethno-linguistic groups adds a

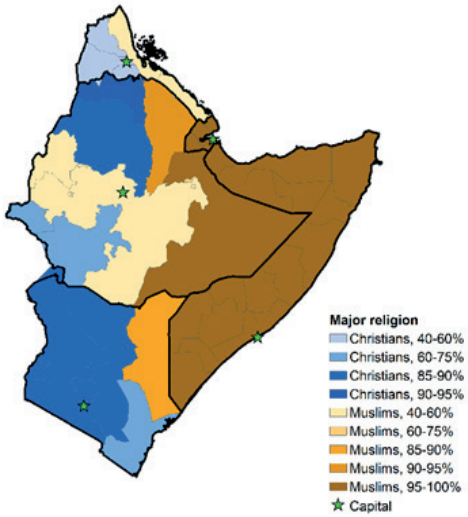
particular significance to the disparities, at times undermining social stability. Integrating lagging and leading areas in this context will require careful consideration on how potential tensions between distinct groups should be managed. On the other hand, the existence of shared identities across the border areas can facilitate cross-border trade and risk management.

Figure 33: Ethno-linguistic families in the HoA



Sources: AfricaMap (Ethnicity Felix 2001) based on the georeferenced version of the People's Atlas of Africa made available by permission from Marc Felix.

Figure 34: Major religions in the HoA



Sources: AfricaMap (World Religion Map) based on World Religion Database (Johnson et al. 2008).

The unofficial cross-border trade in the borderlands of the HoA plays a vital role in the livelihoods of people in the borderlands. A study indeed suggests that it supports about 17 million people along the different value chains, including crop farmers, brokers, crop traders, livestock-keepers, fodder suppliers, ranch owners, itinerant traders, large livestock traders and transporters.[25] It is estimated that this cross-border trade accounts for more than 95 per cent of total (officially recorded and unrecorded) intra-regional trade in the Horn.[26] During 1993-2000, for example, the total value of Ethiopia's unofficial cross-border trade in livestock in the region is estimated to have averaged $105 million, 100 times greater than the average annual official livestock export trade.[27]

Externally, borders between the HoA countries remain thick, hampering the mobility of people and goods across borders. There are limited efforts to legalizing such informal cross-border trade. On the contrary, government policies towards the informal cross-border trade have historically been to focus on curbing it instead of facilitating it.[28] In addition, poor connectivity across key markets in the borderlands has posed an impediment to market integration across the borderlands.

25 Tesfaye and Amaha, 2018.
26 Little, 2007 and 2009.
27 Halderman, 2005.
28 World Bank 2020.

Policies for the lagging areas

a. Integration through spatially blind institutions and policies

The way to deal with lagging areas has traditionally been hotly debated. Many policymakers considered, or still consider, concentration of economic activity as inconsistent with spatial equity in living standards, and have tried to push economic activity or, even worse, people, to areas with low economic and/or population density. According to the 2009 World Development Report on "Reshaping Economic Geography", these spatially targeted development initiatives have either mostly failed or been highly cost-ineffective in attaining their stated objectives. Rather, so-called "territorial development policies" should focus on integrating lagging with leading areas through a variety of spatially blind institutions.

Given the sparsely populated nature of the HoA border areas, policies should first and foremost focus on reducing economic distance with the more developed areas. The 2009 WDR proposed a policy framework based on the characteristics of the lagging areas (Box 4). In case of sparsely populated lagging areas, policies that are universal - spatially blind in their design and coverage – should do the heavy lifting in achieving economic integration. The primary objective of these policies should be to remove as much as possible the obstacles that prevent people in the border areas from migrating to places with better economic opportunities. These obstacles may relate, among others, to poor education services in the lagging regions (skills drive migration and poorly educated people are less likely to migrate) and/or land market distortions that tie people to a specific place. Providing essential services such as basic education and health care, water and sanitation should be universal policy priorities, as well as removing any policy-induced restrictions to mobility.

Box 4: The 2009 WDR policy framework

The 2009 WDR on Reshaping Economic Geography identifies three types of countries, depending on the characteristics of their lagging areas:

- Type 1: Countries with sparsely populated lagging areas
- Type 2: Unified countries with densely populated lagging areas
- Type 3: Divided countries with densely populated lagging areas

In Type 1 countries, the main challenge is economic distance between the lagging and leading areas and policies should focus on reducing that distance. Institutions and policies that are universal in their design and coverage *(spatially blind institutions)* can shoulder much of the task of successful economic integration. The primary objective of these policies should be to encourage people to migrate to places with more economic opportunities. Essential social services such as education, health care, water and sanitation, etc., should be provided to everyone in the country regardless of space and any impediments to mobility should be removed.

In Type 2 countries, high economic distance is coupled with high population densities in lagging areas. For these countries, spatially blind policies and institutions need to be combined with investments in spatially connective infrastructure to improve access of entrepreneurs in lagging areas to markets. Though migration will also aid spatial efficiency and equity in these countries, high population density in lagging areas means that this would

take a long time. Better infrastructural links between lagging and leading areas may, by improving market access, some activities to flourish in lagging areas.

In Type 3 countries, high economic distance and high population density in lagging areas are combined with internal divisions along ethnolinguistic or religious lines. In these countries, factor mobility is constrained and spatially focused incentives may need to complement institutions and infrastructure to encourage economic production in lagging areas. Commonly used incentives include fiscal incentives and subsidies, special economic zones, and industry location regulations. These incentives tend to be costly and should be used as a last resort and always to complement integrative institutions and infrastructure, not instead of it. Policy makers should keep in mind that the primary goal of development is to improve the welfare of people, not of places.

Source: WDR, 2009.

While the border areas of the HoA countries classify as "Type 1" in Box, several countries are to some extent internally divided along ethnolinguistic or religious lines. In these circumstances, much of the policy response should still be spatially neutral, but special efforts may be needed to ensure equal access to public services for people living in the lagging areas. As shown earlier in this paper, people living in the border areas have far worse human capital outcomes. Spatially targeted programs to improve education in the HoA border areas may be needed to facilitate convergence with the more developed areas. In case of persistent labor market gaps, equal opportunity legislation to ensure that workers from culturally distinct lagging areas do not face labor market discrimination in other parts of the country may also be required.

b. Investments in secondary cities

In the lagging areas of the HoA, investing in human capital and removing other obstacles to migration should be the mainstay of development policy. Most of this migration will, at least in the shorter-run, likely not be directed to the national capital or other cities in leading areas, but rather to smaller secondary cities in the lagging areas. In Ethiopia, the urban population is expected to triple by 2034, which much of this increase happening in small towns (less than 50,000 people) and secondary cities (between 100,000 and 500,000).[29] In Kenya, while the urban population is growing relatively fast, Nairobi's share of the urban population is not expected to increase by 2030. In contrast, Kenya is likely to see a larger share of the urban population living in medium cities (between 100,000 and 1 million).[30] These projected trends bode well for poverty reduction: Urbanization through migration to secondary cities has been shown to be more poverty-reducing compared to metropolization (where migration is mainly directed to the capital city).

The projected fast growth of secondary cities calls for substantial investments in public infrastructure and services. Access to public infrastructure and services is generally worse in smaller cities than in the capital, reflecting large cities' better access to

[29] Schmidt et al, 2018.
[30] World Bank, 2016.

finance. This is the case in the HoA as well. Improved human capital in the lagging areas of the HoA – the absolute priority- will likely lead to accelerated migration from rural areas to towns and cities in the border areas. Preparing these secondary cities for a rapidly growing population through coordinated investments in public infrastructure and services will be required to maximize the welfare effects of this spatial shift.

While the biggest urban centers in the HoA are located in the leading areas, there are a number of secondary urban centers in the border areas that play an important role in trade and local economic activity. Using a spatial-demographic approach as outlined in Box 5, some of the major economic and population centers in the border areas include Hargeisa, Kismayo, Galkayo and Borama in Somalia, Asmara in Eritrea, Jijiga in Ethiopia, and El Wak, Mandera and Wajir in Kenya (Figure 35). And these cities have seen a rapid increase in the level of economic activities over time (again proxied by changes in nighttime light) (Figure 36).

Box 5: Identifying urban agglomerations using geospatial data

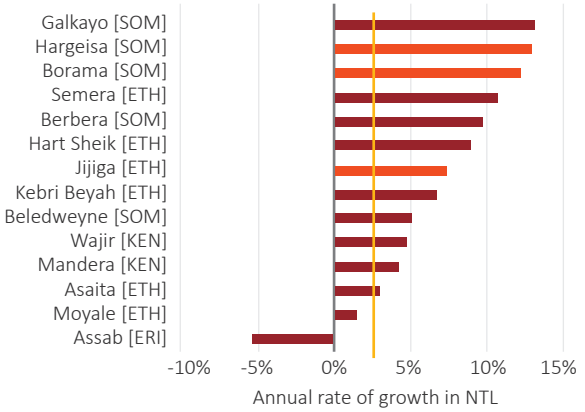
Since there is no standardized definition of urban agglomerations, we rely on a spatial-demographic approach to classifying them. This is an approach used widely in the urban studies literature where some minimum threshold of population density is applied to distinguish between urban and rural settlements (Bundervoet et al., 2017). For this report, we apply a threshold of a minimum of 5,000 persons living at a minimum density of 1,000 persons per kilometer (km) to make this distinction. We used two sources of gridded population data: WorldPop (for Djibouti, Ethiopia, Eritrea, and Kenya) and Global Human Settlement (GHS) database (for Somalia). GHS is used for Somalia because WorldPop detects only a few urban settlements in the country. This is perhaps due to the fact that population estimates are smoothed too thinly across space that only few grids pass the threshold of 1,000 persons per km to qualify for urban settlements in the context of Somalia. GHS allows us to detect many more urban settlements in Somalia, which appear to be more sensible.

Figure 35: Estimated population in urban agglomerations of the borderlands

Sources: WorldPop.

Notes: Population estimates are based on WorldPop estimates of 2020 population at a resolution of 100 meters.

Figure 36: Annual rate of increase in nighttime light in select cities in the borderlands



Sources: WB staff calculations based on Li et al. (2020).

Notes: The vertical line shows the average rate of growth in nighttime light across all urban agglomerations.

c. Leveraging deeper integration across the border areas

Reducing the distance to economic density is the priority for the border areas in the HoA. Economic density does need to be restricted to the leading areas of the same country, however. People in the northeastern Afar region of Ethiopia, for instance, are much closer to the capital of Djibouti than they are to their national capital, Addis Ababa. Similarly, people in Mandera county of Kenya are closer to Mogadishu than they are to Nairobi. Closer integration and *thinning* of the borders between the HoA countries has significant potential to create more economic opportunities and improve welfare, not only for people living in the border areas but the populations at large. For urban centers located in the border areas, closer integration and removing barriers to cross-border trade are likely to spur economic activity and growth, creating more opportunities for both the urban inhabitants and the surrounding rural populations.

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Appendix A

A.1 Main correlates of economic densities and poverty

To assess key correlates with economic densities, we perform a simple OLS regression. The unit of analysis here is the mixture of first-order and second-order administrative areas where the latest household survey is representative. Our dependent variable is the level of economic density measured by estimated GDP per sq. kilometers averaged across those subnational areas.[31] Our key covariates include: population density (or size of population per sq. kilometers), poverty (or share of people living under the international $1.9 poverty line), borderlands (a dummy variable coded 1 if a given area is part of the borderlands as defined in this note), market accessibility,[32] elevation[33] (in km) and share of cropland and grazing/pastoral land.[34]

A simple diagnostic of bivariate relationships between economic densities and other socio-economic indicators after controlling for country-fixed effects suggest that variation in economic densities are strongly correlated with population densities, poverty, market accessibility, and agricultural production. The Shapley decomposition based on Model 7 reveals that population densities account for about half of the overall variation in economic densities (0.454), followed by market access (0.140), share of cropland (0.139) and poverty (0.052).

Table A1: **Regression analysis of economic geography in the Horn of Africa**

Models	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Population density *(ln)*	1.163*** (0.0362)						1.044*** [0.454] (0.0645)
Poverty		-4.107*** (0.880)					-0.985*** [0.052] (0.273)
Borderland			-2.143*** (0.354)				-0.0253 [0.049] (0.156)
Market access				15.45*** (2.968)			3.084*** [0.140] (0.831)
Elevation					1.720*** (0.265)		0.0278 [0.062] (0.129)
% of cropland						6.080*** (0.629)	0.0474 [0.139] (0.382)
% of pastoral grazing/land						1.187 (0.936)	-0.184 [0.029] (0.540)
Observations	155	155	155	155	155	155	155
R-squared	0.917	0.282	0.436	0.503	0.189	0.367	0.929

Notes: Robust standard errors are reported in parentheses and Sharpley values reported in brackets for Model 7 report the marginal contribution of each variable to the overall R2. All regressions control for country-fixed effects. *** p < .01 ** p < .05 * p < .1.

31 Calculated based on Ghosh et al. (2010).

32 See Box 3 for the definition of MAI.

33 Calculated based on SRTM data Version 4 (Jarvis et al. 2008).

34 Calculated based on the data of anthropogenic land use estimates for the Holocene – HYDE 3.2 (Goldewijk et al. 2017).

A similar diagnostic is also undertaken to understand key correlates with subnational poverty rates. For this analysis, we include the same set of covariates as used in Table A 1 but now replace the dependent variable with subnational poverty rates while using subnational GDP as one of the key predictors. The results are reported in Table A 2. The results suggest that poverty is more pronounced in areas that are characterized by low economic densities and poor accessibility. The Shapley values indicate that economic densities account for about 8 percent of spatial variation in poverty, followed by population density (0.053).

Table A2: Regression analysis of subnational poverty in the Horn of Africa

Models	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Population density *(ln)*	-0.036*** (0.010)						0.064** [0.053] (0.032)
Economic density *(ln)*		-0.038*** (0.007)					-0.093*** [0.076] (0.022)
Borderland			0.005 (0.043)				-0.067 [0.007] (0.051)
Market access				-0.784*** (0.226)			-0.150 [0.015] (0.184)
Elevation					-0.040* (0.023)		0.009 [0.050] (0.031)
% of cropland						-0.150** (0.074)	0.031 [0.021] (0.115)
% of pastoral grazing/land						0.031 (0.136)	-0.012 [0.004] (0.135)
Observations	155	155	155	155	155	155	155
R-squared	0.314	0.360	0.240	0.314	0.252	0.258	0.412

Notes: Robust standard errors are reported in parentheses and Sharpley values reported in brackets for Model 7 report the marginal contribution of each variable to the overall R2. All regressions control for country-fixed effects. *** p < .01 ** p < .05 * p < .1.

Appendix B

B.1 Convergence or divergence in local economic growth in the Horn of Africa

To understand the spatial dynamics of local economic growth across the Horn of Africa, we apply Barro and Sala-i-Martin's (1991) framework on β-convergence. More formally, the following regression model is estimated:

$$G_{jct1\text{-}t0} = \alpha + \beta_1 \ln(Light_{jct0}) + \beta_2 Border\ Areas_{jct0} + C_c + \varepsilon_{jct} \quad (1)$$

where $G_{jct1\text{-}t0}$ corresponds to annual growth rate in nighttime light intensity between year t0 and year t1 in ADM2 area j in country c. More formally:

$$G_{jct1\text{-}t0} = \ln(Light_{jct1} / Light_{jct0}) / (t1\text{-}t0) \quad (2)$$

where $Light_{jct0}$ denote the initial level of nighttime light at t0 and β_1 essentially captures the rate of convergence after accounting for other confounding factors X_{jct0}. We add a constant of 1 to the values of nighttime lights so that when these variables are log-transformed, those areas with no luminosity would still stay in the sample. There is conditional convergence (divergence) if β_1 is statistically significant and negative (positive). Also included in this regression is a dummy variable ($Border\ Areas_{jct0}$) coded 1 if a given urban agglomeration lies within the border areas, 0 otherwise. In essence, if $\beta_2$turns out to be statistically significant and positive (or negative), it shows that urban agglomerations in the border areas experienced faster (or slower) growth in nighttime light vis-à-vis other parts of the countries.

According to our results, we find that the estimated coefficient for β_1 is positive and statistically significant. More substantively, changes in the level of economic densities proxied by mean of nighttime light grew more quickly in more-developed areas by an annual divergence rate of 0.5 percent between 1992 and 2013 (Column 1 in Table A-1). On the other hand, the effect of border areas turns out to be negative and statistically significant. More substantively, areas in the borderlands grew slower the rest of the countries by an annual rate of 0.6 percent even after controlling for the initial level of development. These findings attest to the widening spatial gap both between lagging and economically-dense regions and also between the border areas vis-à-vis other areas. These results stand robust to simply using change in the value of mean nighttime light (instead of annual rate of change) (Column 2) or using annual growth rate in building density based on the Global Human Settlement database (Column 3).

Table B1: Results from the β-convergence model

Dependent variable	Annual growth rate in nighttime light (1992-2013)	Change in nighttime light (1992-2013)	Annual growth rate in built-up density (1990-2014)
Model	(1)	(2)	(3)
Ln(Light) at t=0	0.005***	3.786***	
	(0.001)	(0.513)	
Ln(Built-up density)			0.015***
at t=0			(0.002)
Border	-0.006***	-0.169**	-0.001***
	(0.001)	(0.081)	(0.001)
Observations	515	515	515
R-squared	0.164	0.534	0.487

Notes: Robust standard errors are reported in parentheses. All regressions control for country-fixed effects. *** p < .01 ** p < .05 * p < .1.

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