

Is Africa Rising? A Comparative Analysis on Selected African and East Asian Countries

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Abstract

This paper tries to prove whether Africa is rising. To achieve our objective we used simple statistics like averages, multiples (folds), the catching up index to compare Africa's trends of economic growth relative to East Asian countries. We found in bold that Africa is not rising rather swinging back and forth. The total share of Africa from the world population is growing while its share from world GDP is declining over time. This means there is a lower tendency of improving the well-being of society. In 1960 SSA countries had a 2.26 percent share of world GDP. This figure declines to 2.18 percent in 2019. However, in East Asia and the Pacific excluding high-income countries which have nearly the same GDP share in 1960, it increased to 16.9 percent in 2019 while its population share fell from 29.5 percent in 1960 to 27.3 percent in 2019. The catching up index shows no evidence of convergence in African countries and no falling back in East Asian countries. East Asian countries excluding high-income countries were able to increase their GDP and GDP per capita by over 62 and 23 folds between 1960 and 2019. Their GDP per person employed increased by 6 fold from 1991 to 2019. While SSA countries; have only increased GDP by 7 folds, GDP per capita by 49 percent, and GDP per person employed by 35 percent over the same period.

Keywords: Catching-up index, relative convergence, Rising Africa

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1. Introduction

Since the emergence of modern economics accelerating economic growth was the most important issue of policymakers to achieve economic development. Improving people's well-being and socio-economic conditions is therefore one of the crucial challenges facing policymakers and social scientists today. Economists have been working for a long to shed light on why some countries grow faster than others.

Alongside several international organizations like World Bank, IMF, FAO UNICEF, and others are working to secure economic growth, transformation, democracy, and international integration in developing countries. Africa's potential to grow and failures to achieve the goals have become the center of discussions since the end of colonization in the 1960s. During that time East Asian and African countries were at a similar per capita income and economic structure (Collins and Bosworth, 1996). This similarity does not last for long, African countries lag behind while East Asian countries fuel their growth. Scholars refer to this diverged performance of the two regions as the East Asian miraculous growth and the African growth tragedy (Nelson and Pack, 1999 & Easterly and Levine, 1997).

However, politicians and international institutions are making a sound that tells loud success stories in Africa. Since 2010 the headlines of media like The Economist are colorfully printed with saccharine headlines like "Africa's extraordinary boom", "Aspiring Africa", "A hopeful continent" "The African century". This initiates lots of questions into mind. Does Africa rising, how fast are African countries growing relative to the counter partner countries in East Asia and whether is this growth benefiting the poor?

This paper tries to show the on-ground economic performance of African countries relative to East Asian countries as a benchmark to hypothesize the research on sources of economic growth of countries in the two regions.

1.1. The concept of economic growth

Economic performance is a multidimensional evaluation of a country's economy assessed regarding its economic goal. The goal of any country is to improve the living standard of its society. Economists use different indicators to compare the economic performance of different countries. GDP, GDP per capita, investment, saving, capital formation, inflation, unemployment, debt, exports, terms of trade, trade openness, and productivity are some of the indicators. Among all GDP and GDP per capita are considered as the measures for economic growth. Though the idea of GDP dated back to the 18th century the modern concept was developed in 1934 by Simon Kuznets and its popularity grew after the 1944 Bretton Woods conference where it is officially accepted as a tool to measure a country's economy.

Economic growth is most commonly defined as the course of the manner how the country's real gross domestic product or GDP per capita increases in the long run. The increase in GDP Per-Capita is referred to as

the superlative measure for a country's economic growth since it reflects the enhancement of living standards of common people in the country. When measuring economic Growth we need to consider the increase in real National Income not just the increase in money income or the nominal national income. Real economic growth is an escalation in the production of final goods and services not an ordinary increase in the market prices of produced goods and services. The other thing we need to consider in the discussion of economic growth is that the increase in Real Income should be over a long period. Seasonal or temporary increases in income in the short run should not be confused with economic growth (Kuznets 1966 &1971). Economic growth happens due to productivity increases over time.

2. Methods

Descriptive analysis and catching up index are used to articulate the trends of economic growth in African and East Asian countries.

2.1. Nature and source of data

Data on GDP and GDP per capita in 2010 US\$ is collected from World Bank development indicators from 1960 to 2019 for 23 selected African and East Asian countries. These countries are nominated due to their high attention by international institutions and academic researchers related to their fast economic growth aside from the availability of data. Among them, 7 countries are from East Asia while 16 countries are from Africa. Japan and South Korea are high-income countries and Burkina Faso, Ethiopia, Mali Rwanda and Uganda are low-income countries. Under the upper-middle-income category China, Malaysia and Thailand are from East Asia and South Africa is the only country from Africa. Under the lower-middle-income group, the study considered Algeria, Angola, Cote d'Ivoire, Egypt, Ghana, Kenya, Morocco, Nigeria, Senegal, and Tanzania from Africa and Indonesia and Vietnam from East Asia. There is no high-income country from Africa and no low-income country is from East Asia. Regional data is also collected on regions in Africa and East Asia; Eastern and Southern Africa, Western and Central Africa, East Asia & Pacific, East Asia & Pacific excluding high-income countries, and Sub-Saharan Africa.

2.1.1. Variable definition

GDP stands for "Gross Domestic Product" the monetary value of all final goods and services produced within the geographic boundaries of a country or a region over a year.

GDP growth rate measures the percentage change in real GDP from one period to another.

GDP per capita is nominal GDP divided by the mid-year total population of a country. It expresses the average economic output or income per person in the country.

GDP per person employed is gross domestic product divided by total employment in the economy. GDP per person employed represents labor productivity.

Purchasing power parity (PPP) GDP is GDP converted to 2017 constant international dollars using PPP rates. An international dollar has the same purchasing power over GDP that a U.S. dollar has in the United States.

The Population is the total number of people in a country or region in the mid-year.

2.1.2. What do we mean by Sub-Saharan Africa?

Most ordinary people who got a chance to read some research papers or those who are following news and annual reports about Africa might think of SSA as a collection of a few countries in Africa that have some common economic ground. However, according to the United Nations regional classification, SSA consists of all African countries and territories that are fully or partially south of the Sahara desert. The only African countries that are not included in the SSA are five countries in North Africa; Algeria, Egypt, Libya, Morocco, and Tunisia. Hence when we refer to SSA we mean Africa. Eastern and Southern Africa Region refer to 26 countries stretching from the Red Sea in the North to the Cape of Good Hope in the South. The West and Central Africa region comprises 23 countries from the Gulf of Guinea to the southern limit of the Sahara to Gabon.

2.2. Methods of analysis

To address the objective of this research only simple statistics like averages, folds (multiples), and Catching up index are used.

Multiples of GDP and GDP per capita

Making a direct comparison of countries' economic growth over time might be inappropriate due to differences in their initial conditions and institutions. Thus this paper uses multiples of GDP and GDP per capita to make a comparison of the economic performance of a country with itself over time and its relative difference with others. Thus multiple of GDP is calculated by dividing the last period GDP by its initial period GDP. IF a country's economic performance is deteriorating the multiple will have a value less than one.

Catching-up index and relative convergence

There is a conventional understanding called the Convergence hypothesis that states poorer countries to grow faster than rich countries until they "caught up" with the per capita income of the rich countries. This hypothesis

is based on the premise that the lower capital-labor ratio and backwardness in technology adoption in developing countries create a higher return in fixed investment in poor countries that will trigger faster economic growth. Skonhoft (1995) and Lim and Mc Aleer (2004), itemized that follower countries face a better technological frontier and they will adopt newly innovated and highly productive technologies that increase their growth and make catching up possible.

The concept of β -convergence was first introduced by Sala-i-Martin (1990) to test empirically the neo-classical hypothesis that poorer economies tend to grow faster. Barro and Sala-i-Martin (1995) and Sala-i-Martin (1996), used β and σ indicators as a tool for measuring the degree of convergence and the speed for getting convergence. Though the two indicators are related they have different implications. Beta convergence focuses on detecting the possible process of catching up to some steady-state while Sigma-convergence refers to a reduction of disparities among countries or regions in time. When the partial correlation between growth in income over time and its initial level is negative, there is “beta convergence which means poor countries or regions grow faster than rich ones and therefore catch on them.

This paper adopts Chander Kant's (2019) method to calculate the catching up index. The catch-up index and relative convergence are defined as follows. Let Y_{k0} and Y_{j0} represent Country K's and the benchmark country's base year Real GDP per-capita, respectively. And RK_0 is the ratio of real GDP per capita of country K to the reference country J. The benchmark country is the richer country for all; Japan.

Then,

$$RK_0 = Y_{k0}/Y_{j0}$$

For each subsequent year, RK_t , ratios of a country's annual RGDP per-capita to that of the benchmark country are computed as follows.

$$RK_t = Y_{kt}/Y_{jt}$$

Assuming the benchmark country is the richer country for all t, then,

$$RK_t = (Y_{kt}/Y_{jt}) < 1, \text{ for all } t.$$

Country K's catch-up index for year t is the ratio of its RGDP per capita ratio for year t to its base year RGDP per capita ratio. Let IK_t represent this index. Then,

$$IK_t = RK_t/RK_0$$

If the value of the catch-up index is greater than 1, or it increases, it indicates catching-up, i.e., an increase in Country K's RGDP per capita ratio to the frontiers. If it is less than 1, or it decreases, it indicates falling behind or a decrease in Country K's income ratio to the frontiers.

3. Results and discussion

3.1. How big is Africa's share of the world GDP and Population?

The total share of Africa from the world population is growing while its share from world GDP is declining over time. In 1960 SSA countries had a 2.26 percent share of world GDP. This figure declines to 2.18 percent in 2019. However, in East Asia and the Pacific excluding high-income countries which have nearly the same GDP share in 1960 increased to 16.9 percent in 2019. East Asia and Pacific countries increased their GDP share from 11.8 percent to 29.3 percent and their share in the population has dropped from 34.3 percent to 30.5 percent. Contrary to the share in GDP the population in East Asia and the Pacific excluding high-income countries decreased from 29.5 percent in 1960 to 27.3 percent in 2019. Sub-Saharan African countries doubled their share in population from 7.4 percent to 14.4 percent during this same period.

3.2. Is Africa rising?

This is the main theme of this paper. To make our case the paper used GDP, GDP per capita, and GDP per person employed as an indicator of economic growth and productivity.

3.2.1. Growth in GDP by region

In the 1960s SSA and East Asian countries excluding high-income countries have the same growth rate in GDP. The East Asian countries excluding high-income countries' growth rate have an increasing trend over time except for the slight fall in the 2010s. On the contrary, there is a swing in the SSA countries' growth records. The saddle point is the 1980s, the lower growth rate recorded in SSA. Otherwise, it increases for 2 decades and falls for the other 2 decades. The East Asian countries excluding high-income countries' growth rate exceeded the world average in the 1970s while the SSA countries' growth rate was below the world average growth rate until the 2000s.

3.2.2. Growth in GDP by income group

To take into account the heterogeneity among countries in the two regions we also analyzed economic growth by income group. Low-income countries have a lower growth rate in GDP in the initial period and in ascending order initial growth rate goes higher from lower-middle-income countries to upper-middle and high-income countries. For instance in Africa low-income countries grow by 2.9 percent, lower-middle-income countries by 4.5 percent, and upper-middle-income countries by 5.8 percent during the 1960s. Similarly in East Asia, lower-

middle, upper-middle, and high-income countries grow by 3.5, 5.9, and 10 percent respectively.

One can also notice from table 3 the difference in the growth rate of the same income group across the two regions. For instance, lower-middle-income countries grow by 4.5 percent in Africa and by 3.5 percent in East Asia while upper-middle-income group countries grow by 5.8 and 5.9 percent in Africa and East Asia respectively. However African countries' growth rate drops in the 1980s and 1990s while East Asian countries consistently keep growing at a rate higher than 5 to 7 percent on average for five to six decades. In the 1990s lower and upper-middle-income countries grow on average by 2.8 and 1.3 percent in Africa and by 5.8 and 7.5 percent respectively. Table 3 presents the ten-year average growth in GDP of African and East Asian countries categorized by income group. The average growth rate in GDP at the country level is presented in appendix 1.

3.2.3. Multiples of GDP and GDP per capita

This research used multiple of GDP and GDP per capita to show by how many folds countries increased their GDP and GDP per capita in 2019 compared to 1960. According to Bolt et.al (2014), the world GDP per capita has risen 10-fold since 1820. The average level of world GDP per capita increased from USD 650 in the 1820s to USD 1 291 in the 1900s, and from USD 2 405 in the 1950s to almost USD 7 000 in the 2000s. Table 4 presents the multiple of GDP and GDP per capita by region. The world GDP doubled its GDP in 1960 after 14 years in 1974. SSA and East Asian countries excluding high-income countries doubled their GDP in 1976 and 1975 respectively.

The 2019's GDP of the world is 7 fold of the 1960's world GDP. East Asian countries excluding high-income countries increased their GDP by 62 fold while SSA countries increased it only by 7 fold. The world's GDP per capita raised by almost 3 fold from 1960 to 2019. East Asian excluding high-income countries' GDP per capita in 2019 is more than 23 folds of 1960s GDP per capita. However SSA countries failed to double their GDP per capita during this period, it only increased by 49 percent in 59 years.

African countries multiplied their GDP in a range between 3 times and 19 times. Of the 16 African countries, only Egypt was able to increase GDP in a multiple of 19. While in East Asian Indonesia 19.88, Thailand 28.94, Malaysia 36.13 Korea 63.6 and china 89.97 times higher GDP in 2019 compared to 1960. The lower multiple is recorded by Vietnam 8.94 and Japan 7.77. This is because Japans' GDP was already higher in 1960 and Vietnams' data start from 1984 where the GDP of the country is also higher than in 1960.

Correspondingly GDP per capita increased in a higher multiple in East Asian countries. Egypt which recorded the highest multiple in GDP even has a lower multiple in GDP per capita compared to Vietnam and Japan that have the lower GDP multiple in East Asia. Among the 17 African countries, only 8 countries were able to increase their GDP per capita by more than twofold. Mali, Uganda, Ethiopia, Rwanda, and Kenya increased GDP per capita by twofold, Burkina Faso by 3 folds, morocco by 4, and Egypt by 5 folds.

3.2.4. GDP per capita Vs. GDP per person employed

Growth in GDP per capita measures the increase in the average economic well-being in the country while growth in GDP per person employed addresses productivity. The first adjust gross GDP growth for whether the population is increasing, stable, or declining. And GDP per person employed adjusts for changes in the composition of the population among those who are employed. There is no data on GDP per person employed before 1990. We used the World Bank dataset on GDP per person employed and GDP per capita on the constant 2017 PPP dollar starting from 1991.

Table 6 presents GDP per person employed by region and it shows that both regions have productivity is lower than the world average, though East Asian countries are reducing their gap with the world frontiers. GDP per person in SSA was higher than that of East Asia and the Pacific excluding high-income countries in 1991. However of East Asia and the Pacific excluding high-income countries were able to increase their productivity by more than 6 folds in 2019, in 28 years. During this same period, SSA countries increased productivity only by 35 percent.

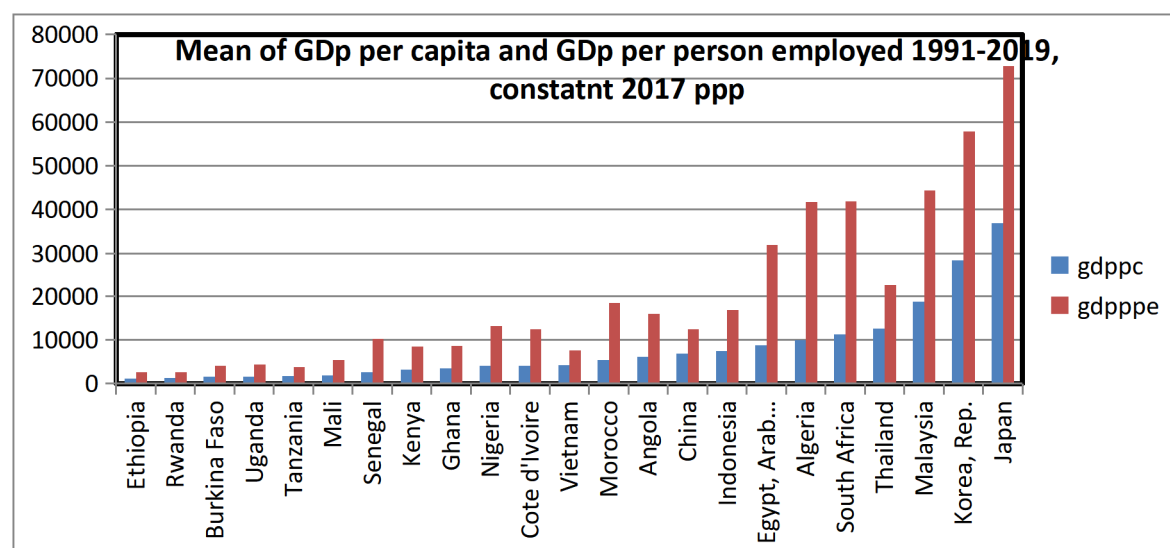


Figure 1 Mean of GDP per capita and GDP per person employed 1991-2019

African countries have a tremendously low GDP per capita and GDP per person employed. Figure 1 showed that Egypt, Algeria, and South Africa are the best performing African countries though there is a large gap between the two variables within countries. For instance, Malaysia has nearly the same GDP per person employed as Algeria and South Africa, however, the GDP per capita of these two countries is very low compared to Malaysia. This implies that an equivalent increase in productivity brings a higher change in living standards in Asian countries than it brings in African countries.

3.3. Catching-up index and relative convergence

The most remarkable finding from the results shown in table 7 is that there is no evidence of any catching up in African countries while all East Asian countries are converging to Japan's economy with continuously increasing catch-up indexes. All African countries fall back including South Africa and Algeria, countries with the highest real GDP per capita in 1960. The catch-up index of African countries was higher in the 1960s while it continues declining until the end of the 1990s and a slight recovery has been shown in the 2000s and 2010s. For instance catching up indexes falls from 0.94 to 0.54 in Burkina Faso, from 0.9 to 0.31 in Nigeria, and from 0.93 to 0.28 in South Africa. In East Asian countries catching up indexes rises from 0.94 to 1.13 in Indonesia, from 0.96 to 1.66 in Malaysia, from 0.94 to 1.99 in Thailand, and from 0.67 to 7.5 in China. All these indicators of divergence between African and East Asian countries urge to identify the sources of economic growth in these countries.

4. Conclusion and recommendations

Economists use different indicators to compare the economic performance of different countries. In this paper GDP, GDP per capita, and GDP per person employed are used to show the patterns of economic growth, the wellbeing of the society, and productivity of workers in African and East Asian countries.

(Pritchett 2000) stated that countries experience a varying length of expansion, contraction, and stagnation at different times in history. Easterly et al. (1993) also confirmed the existence of instability in the economic performance of the majority of countries and only a few countries were able to sustain high growth for several decades. African countries are among countries that experienced instability in their economic performance. In the 1960s SSA and East Asian countries excluding high-income countries have the same growth rate in GDP. The East Asian countries excluding high-income countries' growth rate have an increasing trend over time except for the slight fall in the 2010s. On the contrary, there is a swing in the SSA countries' growth records. All indicators of economic performance in Africa show an increase in the 1970s and they fall in 1980s and 90s and they recover in 2000 and fall again in 2010s.

To address the heterogeneity of countries' economic performance we analyzed growth by income group and country level. We found strong evidence on the power of Initial conditions to determine the economic growth of a country. Low-income countries have a lower growth rate in GDP in the initial period and in ascending order initial growth rate goes higher from lower-middle-income countries to upper-middle and high-income countries.

Abramovitz (1986) argued that being backward does not mean being backward forever because a lower level of productivity carries a potential for rapid advance. East Asian countries used this lower productivity potential and started the journey of catching up however African countries failed to exploit the potential of lower productivity. GDP per person employed in SSA was higher than that of East Asia and Pacific excluding high-

income countries in 1991. However, East Asia and the Pacific excluding high-income countries were able to increase their productivity by more than 6 folds in 2019, in 28 years. During this same period, SSA countries increased productivity only by 35 percent. The East Asian countries excluding high-income countries' average GDP growth rate exceeded the world average in the 1970s while the SSA countries' growth rate was below the world average until the 2000s.

Preaching a “rising Africa” by politicians and international media shadows the fact that Africa’s economic performance has a swinging trend. The 2019’s world GDP is 7 fold of the 1960's world GDP. East Asian countries excluding high-income countries increased their GDP by 62 fold while SSA countries increased it only by 7 fold. The world's GDP per capita raised by almost 3 fold from 1960 to 2019. East Asian excluding high-income countries' GDP per capita in 2019 is more than 23 folds of 1960s GDP per capita. However SSA countries failed to double their GDP per capita during this period, it only increased by 49 percent in 59 years.

African countries multiplied their GDP in a range between 3 times and 19 times. Of the total 16 African countries, only Egypt was able to increase GDP in a multiple of 19. While in East Asia, Indonesia 19.88, Thailand 28.94, Malaysia 36.13 Korea 63.6 and china 89.97

Thus a further investigation is necessary to identify the causes of divergence between countries in the two regions.

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I, Tigist Zelalem initiated the general research question of this research and the construction of the concepts and methods of analysis.

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<http://www.differencebetween.net/business/difference-between-gdp-and-gdp-per-capita/#ixzz794b64sBG>

Table 1 Share of GDP and population by region

Regions	GDP share by Region		population share	
	1960	2019	1960	2019
Africa Eastern and Southern	0.0136	0.0124	0.0431	0.0860
Africa Western and Central	0.0090	0.0094	0.0318	0.0582
East Asia & Pacific	0.1177	0.2933	0.3435	0.3050
East Asia & Pacific (excluding high income)	0.0229	0.1687	0.2951	0.2729
Sub-Saharan Africa	0.0226	0.0218	0.0749	0.1443

Table 2 Growth in GDP by Region

Regions	Ten years Average growth in GDP					
	1961-70	1971-80	1981-90	1991-2000	2001-2010	2011-19
Africa Eastern and Southern	4.93	3.27	1.99	2.01	4.69	3.07
Africa Western and Central	4.51	4.46	0.66	2.16	6.53	3.65
East Asia & Pacific	7.99	4.89	5.19	3.69	4.49	4.35
East Asia & Pacific (excluding high income)	4.69	6.58	7.22	8.12	9.07	6.88
Sub-Saharan Africa	4.69	3.78	1.41	2.06	5.42	3.32
World	5.36	3.87	3.14	2.81	2.86	2.82

Source: Author's calculation based on World Bank development indicators data set 1960-2019

Table 3 Growth in GDP by income level

Africa			Asia		
Income level	period	Growth in GDP	Income level	period	Growth in GDP
low	1960-69	2.8527856	high	1960-69	9.9693569
	1970-79	4.5857902		1970-79	7.3888087
	1980-89	3.0057247		1980-89	6.6057431
	1990-99	4.0677225		1990-99	4.4092477
	2000-09	6.8404059		2000-09	2.7212468
	2010-19	6.5555198		2010-19	2.2979734
Lower middle	1960-69	4.5200562	Lower middle	1960-69	3.5406786
	1970-79	5.619837		1970-79	7.2071494
	1980-89	2.7085977		1980-89	5.3600345
	1990-99	2.7698489		1990-99	5.864031
	2000-09	5.0080476		2000-09	5.8753127
	2010-19	4.6105731		2010-19	5.8636617
Upper middle	1960-69	5.7736611	Upper middle	1960-69	5.9104578
	1970-79	3.2521826		1970-79	7.6840003
	1980-89	2.2352505		1980-89	7.6362162
	1990-99	1.3860452		1990-99	7.4814176
	2000-09	3.59983		2000-09	6.4844401
	2010-19	1.6816418		2010-19	5.5500545

Sources: Authors calculations based on World Bank development indicators data set 1960-2019.

Table 4 Multiples of GDP and GDP per capita by region

Regions	GDP		GDP per capita		
	GDP doubled in	GDP 2019/1960	1960	2019	2019/1960
Africa Eastern and Southern	1977	6.759	1180.425	1598.4	1.354
Africa Western and Central	1976	7.734	1052.738	1789.5	1.700
East Asia & Pacific	1969	17.664	1278.855	10645	8.324
East Asia & Pacific (excluding high income)	1975	62.169	290.019	6846.8	23.608
Sub-Saharan Africa	1976	7.155	1124.893	1675.7	1.490
World	1974	7.195	3733.402	11073	2.966

Sources: Authors calculations based on World Bank development indicators data set 1960-2019.

Table 5 Multiples of GDP and GDP per capita by country

Country Name	multiple of GDP	multiple of GDP per capita	data starts	Years	Country Name	multiple of GDP	multiple of GDP per capita	data starts	Years
Angola*	3.72	0.97	1980	39	Cote d'Ivoire	10.35	1.41	1960	59
Tanzania*	4.88	1.99	1980	39	Morocco*	10.57	4.16	1966	53
South Africa	5.44	1.59	1960	59	Rwanda	11.03	2.57	1960	59
Senegal	5.91	1.16	1960	59	Burkina Faso	12.87	3.06	1960	59
Algeria	7.38	1.89	1960	59	Kenya	14.91	2.30	1960	59
Nigeria	7.77	1.75	1960	59	Egypt	19.61	5.20	1960	59
Japan	7.80	5.71	1960	59	Indonesia	19.88	6.45	1960	59
Mali*	8.00	2.32	1967	52	Thailand	28.94	11.39	1960	59
Uganda*	8.02	2.39	1982	37	Malaysia	36.13	9.22	1960	59
Ghana	8.17	1.78	1960	59	Korea, Rep.	63.60	30.77	1960	59
Ethiopia*	8.21	2.64	1981	38	China	89.97	42.94	1960	59
Vietnam*	8.94	5.52	1984	35					

Sources: Authors calculations based on World Bank development indicators data set 1960-2019, 2010 constant US\$.

Table 6 GDP per person employed by region

Regions	GDP per person employed 2017 PPP		
	1991	2019	2019/1991
Africa Eastern and Southern	7609.143	9172.606	1.205472
Africa Western and Central	7994.112	12759.41	1.5961
East Asia & Pacific	10307.588	33932.36	3.291979
East Asia & Pacific (excluding high income)	4450.979	27656.88	6.213664
Sub-Saharan Africa	7763.390	10481.73	1.350149
World	22931.539	39552.91	1.724826

Table 7 catching up index by country

Country Name	yr1960	yr2019	RK0= RGDPPCk/RGDPPCj		Ikt= RKt/RK0		Average Catch-up index (Ikt)					
			1960	2019	1961	2019	1961-69	1970-79	1980-89	1990-99	2000-09	2010-19
Algeria	2480.95	4699.76	0.29	0.10	0.77	0.33	0.59	0.49	0.43	0.29	0.32	0.35
Burkina Faso	268.74	822.20	0.03	0.02	0.94	0.54	0.73	0.48	0.40	0.34	0.41	0.50
China	191.96	8242.05	0.02	0.17	0.67	7.51	0.58	0.54	0.75	1.30	2.83	6.05
Cote d'Ivoire	1225.53	1727.28	0.14	0.04	0.97	0.25	0.83	0.70	0.42	0.24	0.20	0.21
Egypt, Arab Rep.	578.60	3010.15	0.07	0.06	0.94	0.91	0.78	0.57	0.66	0.62	0.75	0.87
Ghana	1056.73	1884.28	0.12	0.04	0.92	0.31	0.67	0.37	0.21	0.18	0.20	0.28
Indonesia	690.37	4450.72	0.08	0.09	0.94	1.13	0.68	0.54	0.58	0.64	0.72	1.00
Kenya	537.46	1237.50	0.06	0.03	0.82	0.40	0.70	0.57	0.46	0.34	0.31	0.37
Malaysia	1353.97	12486.68	0.16	0.25	0.96	1.61	0.80	0.73	0.79	0.93	1.14	1.45
Nigeria	1360.42	2374.37	0.16	0.05	0.90	0.31	0.69	0.57	0.32	0.22	0.26	0.33
Rwanda	351.38	901.30	0.04	0.02	0.86	0.45	0.61	0.40	0.35	0.21	0.26	0.39
Senegal	1361.70	1584.47	0.16	0.03	0.92	0.20	0.65	0.35	0.24	0.16	0.17	0.19
South Africa	4624.08	7345.96	0.54	0.15	0.93	0.28	0.78	0.55	0.40	0.27	0.28	0.30
Thailand	570.86	6501.56	0.07	0.13	0.94	1.99	0.82	0.76	0.85	1.19	1.45	1.85
Japan	8607.62	49187.83										

RK0, Ratio of GDP per capita of a country compared to GDP per capita of the leading economy (Japan).

IKt, Catch-up index, the ratio of GDP per capita ratio of a country in period t (RKt) to the initial period (RK0)

Appendix 1

	Average Growth in GDP					
	1960-69	1970-79	1980-89	1990-99	2000-09	2010-19
Algeria	4.10523	7.164635	2.79906	1.57	3.89	2.67
Angola	NA	NA	2.494807	1.175021	8.748049	2.17833
Burkina Faso	3.267762	3.275369	3.736392	5.122707	5.292415	6.015431
China	3.366667	7.38773	9.739276	9.9949	10.35069	7.677913
Cote d'Ivoire	8.712924	7.612248	-0.23618	2.446601	0.705399	6.252409
Egypt, Arab Rep.	5.055649	6.217565	6.68582	4.489174	4.981428	3.801107
Ethiopia	NA	NA	2.352777	2.664089	8.100123	9.778678
Ghana	2.301694	1.446233	1.992853	4.265169	5.364102	6.796091
Indonesia	3.540679	7.207149	5.772238	4.309047	5.105537	5.416122
Japan	10.44485	4.253183	4.329805	1.517125	0.526378	1.283691
Kenya	5.718482	7.158076	4.224502	2.244045	3.573235	5.840033
Korea, Rep.	9.493866	10.52443	8.881681	7.301371	4.916116	3.312256
Malaysia	6.549116	8.155	5.87457	7.247882	4.787348	5.331944
Mali	1.969705	5.209536	2.57456	3.905469	5.33708	4.389747
Morocco	9.427582	5.335957	4.833625	3.210418	4.767737	3.475189
Nigeria	2.851528	6.999647	-0.93386	2.314213	7.6751	3.649759
Rwanda	2.634049	5.272466	3.225138	1.763238	8.334536	7.163356
Senegal	1.259045	3.024336	2.389792	2.715171	4.016027	5.135548
South Africa	5.773661	3.252183	2.235251	1.386045	3.59983	1.681642

	Average Growth in GDP					
	1960-69	1970-79	1980-89	1990-99	2000-09	2010-19
Tanzania	NA	NA	3.764443	3.268678	6.359399	6.307264
Thailand	7.815591	7.509271	7.294802	5.201471	4.31528	3.640306
Uganda	NA	NA	3.010644	6.88311	7.137875	5.430387
Vietnam	NA	NA	4.535628	7.419015	6.645088	6.311202

