The Lion on the Move Towards the World Frontier: Catching Up or Remaining Stuck?

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The Lion on the Move Towards the World Frontier: Catching Up or Remaining Stuck?[*]

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Abstract

The remarkable growth spurt reported by the Sub-Saharan African (SSA) economy since the mid-1990s offers the opportunity to revisit the narrative of its economic development experience. We investigate whether the SSA economy has initiated a gradual process of convergence which reverses the long-term fall so far behind the U.S. frontier. Our framework begins with a top-down approach that performs a nested development accounting exercise. This aggregate analysis complements a bottom-up approach that tracks the sectoral origins of the SSA aggregate relative labor productivity performance. The application of this framework to a representative sample of the SSA economy over the 1970-2010 period suggests the following set of results. After one-quarter of a century of falling behind the U.S. level of real income per capita, the SSA economy observed a swift turnaround towards the end of the 1990s, yet without showing any sign of catch-up. Second, parallel to favorable demographic developments, SSA reports a startling relative labor productivity gap which accounts for much of its relative income per capita gap. Third, the use of the concept of cognitive skills reveals that human capital considerations have worsened off over time, making total factor productivity no longer the biggest part of the story underlying relative labor productivity differences. Fourth, the sectoral evidence points to the coexistence of headwinds (negative within- and reallocation-effects) and tailwinds (between-effects) which tend to cancel out each other, thus preventing SSA aggregate economic performance to get anywhere closer to the world frontier even during the growth spurt period.

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1   Introduction

Global real income per capita advanced from \$3,725 in 1970 to \$7,814 in 2010 (The Maddison-Project, 2013). Although slightly more rapid than the advance reported during the two preceding decades, this twofold gain was not uniformly shared between nations. While the development path of nations is full of contrasts, the debate invariably revolves around the notion of convergence which encapsulates the following basic question: Why do some nations make great progress in catching up while others are mired in stagnation and some continuously fall behind? This question remains all the more relevant in the post-1990 global economy propelled forward by the growth resurgence of developing nations. The African continent has not been immune to this global tide, with the result that some of its constituent countries have become part of the high-growth club for the first time since their independence (see Rodrik 2012).

The recent years have amply illustrated the big reversal of Africa's fortune to the point that, in just one decade, The Economist magazine has gone from referring to Africa as "the hopeless continent" to a "rising star" (The Economist 2000, 2011). Sub-Saharan Africa (SSA), which comprises many countries stuck in a poverty trap, has also been an integral part of this economic momentum. The 1990-2010 period was exceptional in comparison with the growth experience during its lost decades. Although growth rates differ across the SSA constituent countries, the data, nonetheless, began to point to a remarkable transformation. For example, according to the World Bank's World Development Indicators (WDI), the SSA economy (all income levels) reported a 0.9% annual growth of real GDP per capita (at constant 2005 US\$) during 1990-2010, compared to a -0.3% growth reported two decades earlier, a turnaround that contributed to recede some of the detrimental effects of poverty and mortality that have long been at the center of the development challenges of the SSA.[1]

While the SSA growth resurgence has triggered local pride, foreign envy, and enthusiasm

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[1]These figures are based on the definition of SSA retained in the WDI (accessed on December 2014), which comprises the 49 SSA countries that are classified in a wide range of per capita income levels.

from international policy-makers, a more sober discussion needs to take place inquiring, in particular, whether this economy has managed to close the gap with the world frontier and not simply whether it may become richer following its recent growth spurt. The answer to this question is quintessential to our understanding on whether the current episode experienced by the SSA is indicative that something has changed or whether this is yet another false start like this economy was accustomed to.

We tackle this question with a combination between a top-down approach, which performs a development accounting exercise at the macroeconomic level, with a bottom-up approach that traces the sources of the SSA economy relative productivity gap to its sectoral origins. The development accounting exercise provides a necessary documentation of facts before advancing any hypothesis on the changing fortunes of the SSA economy. For example, if gaps in factor endowments explain much of the difference in incomes, then policy-making should place the emphasis on impediments that are holding back the efficient use of factor inputs. In contrast, if factor endowments gap is not the story, then the relatively low efficiency in the use of the factor input endowments deserves the attention of policy makers. Moving beneath the aggregate data offers additional insights that are otherwise not possible using aggregate data. Two empirical questions are at issue: First, is the lack of convergence observed with the aggregate data confined in some large sectors such as agriculture or is it endemic across all sectors? Second, how much of the overall productivity gap results from within-effects as opposed to between- or reallocation-effects? For example, if the absence of convergence is broad-based then research should place the emphasis on an economy-wide explanation rather idiosyncratic factors.

While the combination between the top-down and the bottom-up approaches has been widely exploited in the growth accounting literature, this represents, to the best of our knowledge, the first attempt to extend this set up to the realm of economic development for the SSA region. We apply this framework to the 11 economies of the SSA region that offer some of the most reliable sectoral data all the while remaining representative both in terms

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of breadth and relative importance. In particular, the sample covers landlocked, resource-scarce economies (Ethiopia and Malawi), some coastal, resource-scarce economies (Ghana, Kenya, Mauritius, Senegal and Tanzania) and some resource-rich countries (Botswana, Nigeria, South Africa and Zambia), altogether accounting for close to 70% of the GDP of the SSA economy (all income levels) reported in the WDI. While we cover the 1970-2010 period, we contrast the lost decades that spanned much of the 1970-1990 sub-period with the 1990-2010 sub-period of economic resurgence. The earlier sub-period features a long and severe slump, a result of misguided economic policies implemented as part of the development policies of the SSA economies during the 1970s. In contrast, the subsequent sub-period was marked by a reduction of armed conflicts, the inception of some market-friendly policy reforms, a better governance combined with a fiscal prudence, and a reduction of red tape—all of which fueled the turnaround of the SSA economy.

The analysis of the relative performance of the SSA economy that we provide articulates many angles of analysis that remain untapped in the literature on the recent resurgence of the SSA economy. At the macroeconomic level, several results stand out: First, the SSA's relative GDP per capita declined steadily from almost 10% in the early 1970s to a historical low of 3.6% in 1998. The turnaround at the turn of the new millennium brought the ratio back to 5.6%—one-third of the six percentage points of the real per capita income lost during the 1970-1998 period. The SSA's relative productivity level exhibited the same downward slide at about the same rate from about 10% during the 1970s and early 1980s to a little less than 7% in the late 1980s. Over the entire 1970-2010 period, labor productivity remained slightly above that of GDP per person, a result due to the fact that the SSA had a level of employment per capita close to that of the U.S. combined with a relatively more favorable demographic dividend—both of which though were not large enough to compensate for the startling labor productivity gap. Second, we emphasize that alternate measures of human capital alters considerably the story on the underlying sources of the relative labor productivity gap. Under a more plausible measure based on cognitive skills, SSA's relative

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human capital dwindled over time making total factor productivity (TFP) no longer the primary source of labor productivity gap.

The sectoral evidence suggests that the lackluster and persistently low aggregate relative labor productivity reflects the combination of tailwinds and headwinds. The headwinds faced by the SSA are reflected by negative within- and reallocation-effects which pulled down SSA's relative labor productivity. The within-effects, larger in terms of order-of-magnitude, reflect the joint gap due to capital-deepening and technology, while the reallocation-effects are indicative of an atypical process of structural transformation—away from and towards sectors with a relatively low productivity. The between-effects, which captures allocative efficiency gains, wiped out all of the adverse effects that arise from within and reallocation effects. The same story generally holds during 1990-2010, regarded as the renaissance period of the SSA economy. This suggests that, while advances in the allocative efficiencies have been the only good news, they were not large enough to bring SSA economy anywhere closer to the world frontier.

This paper complements the nascent literature on the resurgence of the SSA economy. Our contribution echoes a recent development in the literature, best represented by Rodrik (2012), who places the debate of Africa's first ever participation in the high-growth club in a broader perspective of economic convergence. We quantify this process using well-tested and well-established methods with new and enhanced source data. In particular, we combine a top-down approach which sorts out the relative importance of the factors that explain the changes in relative real income per person with the bottom-up approach which moves beneath the aggregate data to gain insights into the sectoral sources to the aggregate convergence.

Examples of the top-down approach include Klenow and Rodríguez-Clare (1997), Hall and Jones (1999), Caselli (2005), and Hsieh and Klenow (2010). We extend this literature by superseding the traditional measure of human capital based on number of years of schooling (whether students attended school) with a novel measure that features cognitive skills (whether students effectively learned), forcefully advocated by Hanushek and

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Woessman (2008) in their comprehensive survey. Our work is closer to Erosa et al. (2010), Caselli (2015), and Cubas et al. (forthcoming) who exploited the notion of cognitive skills in a development accounting exercise. Our results based on this new measure reveal that SSA possesses a considerable relative deficit in skills compared to the optimistic prospect offered by the conventional measure. Considering that "human capital gaps are the hardest to bridge" (see, for example, Caselli and Tenreyro, 2006), this clearly adds one more layer of headwinds above and beyond those that are already holding back SSA development.

The bottom-up approach, which rests on a decomposition formula devised by Caselli and Tenreyro (2006), quantifies the relative importance of within-, between-, and reallocation-effects in the convergence of SSA aggregate labor productivity to the U.S. frontier. Thus, our formula, which stresses the notion of relative performance, differs from those employed by McMillan et al. (2014) and de Vries et al. (2015) who place the focus on the performance of the SSA economy *per se*, without any consideration on how far this gets SSA closer to the world frontier. Despite the long history of this sorts of decomposition formulas, a consensus on a single standard approach has not emerged. For example, in the context of the SSA economy, McMillan et al. (2014) do not explicitly account for the between-dynamic-effects (the joint effect of changes in sector employment and productivity levels), while they are regarded as being analytically important by de Vries et al. (2015). Whatever these differences, our decomposition highlights the weak economic fundamentals behind the wakening pulse of SSA economy.

The remainder of the paper is organized as follows. Section 2 outlines the convergence accounting framework that traces the sources that drive the labor productivity level gap between the SSA and the U.S. Section 3 discusses the sources data along with the results of the quantitative analysis, and Section 4 concludes.

2 The Convergence Accounting

In this paper, we follow a well-established practice in the literature of economic development by assessing whether SSA economy is getting closer to the world frontier represented by the U.S. economy in a process referred to as catch-up. This exercise offers the possibility to track economic progress of the SSA economy and to formulate policy accordingly depending on where the gaps originate from.

2.1 Aggregate Analysis

We consider a variant of the development accounting exercise which nests the sources of change in real GDP per capita (q_t^{SSA}) with those underlying labor productivity. GDP per capita can be decomposed into three components: demographic factors, i.e. how many people in the total population are available for work, namely the demographic dividend (n_t^{SSA}); labor market activity which is tracked by the employment rate—the fraction of the potential labor force (representing the population between 15-64 of age) that is employed (e_t^{SSA}); and the efficiency with which employed workers are utilized in the economy, i.e. labor productivity (y_t^{SSA}). Formally:

$$q_t^{SSA} = y_t^{SSA} \times e_t^{SSA} \times n_t^{SSA}, \tag{1}$$

$q_t^{SSA} \equiv (Y_t/N_t)^{SSA}, y_t^{SSA} \equiv (Y_t/E_t)^{SSA}, e_t^{SSA} \equiv (E_t/N_t^{15-64})^{SSA}$ and $n_t^{SSA} \equiv (N_t^{15-64}/N_t)^{SSA}$, where Y, E, N^{15-64} and N represent, respectively, real GDP, employment, working age population, and total population in the SSA economy at time t.

The term demographic dividend was used by Bloom and Williamson (1998) to illustrate the importance of demographic factors in the East Asian miracle. This concept tracks the reduction in the proportion of non-productive dependents in the population which can result from: i) the fall in the fertility rate (made possible by significant reductions in child/infant mortality rates) and/or ii) an extension in average life expectancy that translates into an

increase in the portion of the population that is in the working-age group. The decline in the proportion of non-productive dependents is expected to reduce social spending and spur real income per capita. According to Bloom et al. (2003), countries that reaped the benefits of the demographic dividend have generally shown rapid economic growth that moved them closer to the world frontier. In his broad-brush review of this concept, Williamson (2013) went as far as to conclude that the empirical evidence is in support of the hypothesis that demographic dividend was essential to East Asia's economic record, accounting for as much as one-third of its economic miracle.

We further apportion labor productivity, y_t^{SSA}, between endowments and TFP using the following constant returns to scale Cobb-Douglas technology:

$$Y_t^{SSA} = A_t^{SSA} \left(K_t^{SSA} \right)^{\alpha_{SSA}} \left((hE)_t^{SSA} \right)^{1-\alpha_{SSA}}, \tag{2}$$

where A, K, h, and α are, respectively, TFP, the stock of capital, human capital per worker, and capital factor income share. Following Caselli (2005), we re-write (2) in an intensive form to arrive at the following decomposition of labor productivity:

$$y_t^{SSA} = A_t^{SSA} \left(k_t^{SSA} \right)^{\alpha_{SSA}} \left(h_t^{SSA} \right)^{1-\alpha_{SSA}}, \tag{3}$$

where k ($\equiv K/E$) represents capital deepening. Expressing the SSA performance relative to that of the U.S. leads to the following re-write of GDP per capita and labor productivity:

$$\frac{q_t^{SSA}}{q_t^{US}} = \frac{y_t^{SSA}}{y_t^{US}} \times \frac{e_t^{SSA}}{e_t^{US}} \times \frac{n_t^{SSA}}{n_t^{US}}, \tag{4}$$

and

$$\frac{y_t^{SSA}}{y_t^{US}} = \frac{A_t^{SSA}}{A_t^{US}} \times \frac{\left(k_t^{SSA} \right)^{\alpha_{SSA}}}{\left(k_t^{US} \right)^{\alpha_{US}}} \times \frac{\left(h_t^{SSA} \right)^{1-\alpha_{SSA}}}{\left(h_t^{US} \right)^{1-\alpha_{US}}}, \tag{5}$$

which constitute the metric to track the relative performance of the SSA economy over time.

2.2 Sectoral Analysis

We have, so far, outlined the macroeconomic framework that quantifies how much of the real GDP per capita convergence is attributable to labor productivity, labor utilization, and demographic dividend. Labor productivity is further decomposed into capital deepening, human capital, and TFP. We now turn our attention to the sectoral sources of the aggregate labor productivity convergence.

We perform a convergence decomposition exercise using the same approach employed by Caselli and Tenreyro (2006) in their convergence accounting exercise for Europe. The decomposition tracks three channels to the aggregate convergence:

$$
\underbrace{\Delta \frac{y_t^{SSA} - y_t^{US}}{y_t^{US}}}_{\substack{\text{Aggregate} \\ \text{convergence}}} = \underbrace{\sum_{j=1}^{J} \bar{s}_{j,t}^{SSA} \Delta \left(\frac{y_{j,t}^{SSA} - y_{j,t}^{US}}{y_t^{US}} \right)}_{\substack{\text{Within-sector} \\ \text{convergence}}} + \underbrace{\sum_{j=1}^{J} \overline{\left(\frac{y_{j,t}^{SSA}}{y_t^{US}} \right)} \Delta s_{j,t}^{SSA} - \sum_{j=1}^{J} \overline{\left(\frac{y_{j,t}^{US}}{y_t^{US}} \right)} \Delta s_{j,t}^{US}}_{\substack{\text{Labor reallocation} \\ \text{convergence}}}
$$

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+ \underbrace{\sum_{j=1}^{J} \left(\bar{s}_{j,t}^{SSA} - \bar{s}_{j,t}^{US} \right) \Delta \left(\frac{y_{j,t}^{US}}{y_t^{US}} \right)}_{\substack{\text{Between-sector} \\ \text{convergence}}}, \quad (6)
$$

where aggregate labor productivity of country i ($= SSA, U.S.$) at time t constitutes a weighted sum of the $j = 1, 2, ..., J$ sectoral labor productivity levels, $y_t^i = \sum_{j=1}^{J} s_{j,t}^i y_{j,t}^i$, with $s_{j,t}^i$ representing the share of employment of sector j in the overall economy and the operators Δ and $^-$ are defined as: $\Delta x_{j,t} = x_{j,t} - x_{j,t-1}$ and $\bar{x}_{j,t}^i = \frac{x_{j,t}^i + x_{j,t-1}^i}{2}$. The term *within-sector convergence* captures the productivity catch-up of each sector with the corresponding one in the U.S. weighted by the average employment share in that sector. The term *labor reallocation convergence* quantifies the part of convergence that occurs due to inter-sectoral labor movements weighted by the relative productivity of the sector. The term *between-sector convergence* suggests that if the productivity of the sectors in which SSA has a disproportionate share of labor converges to the overall productivity of the U.S. economy, then convergence can potentially occur. Put differently, advances in solving allocative

inefficiencies can turn to be a source of convergence.

While the above formula can be applied to the entire ς to τ period, it requires a slight modification to accommodate the split of this period between the sub-periods ς to ς' and ς' to τ. Following Caselli and Tenreyro (2006), Equation (6) is re-written in a way to capture a revival or deterioration during the ς to τ compared to ς to ς'. First, within-sector convergence during the ς to τ period $(WSC_{\varsigma-\tau})$ is decomposed as:

$$WSC_{\varsigma-\tau} = \underbrace{\sum_{j=1}^{J} \bar{s}_{j,\tau}^{i} \Delta_{\varsigma'-\tau}\left(\frac{y_{j,t}^{i} - y_{j,t}^{US}}{y_t^{US}}\right)}_{WSC_{\varsigma'-\tau}} + \underbrace{\sum_{j=1}^{J} \bar{s}_{j,\tau}^{i} \Delta_{\varsigma-\varsigma'}\left(\frac{y_{j,t}^{i} - y_{j,t}^{US}}{y_t^{US}}\right)}_{WSC_{\varsigma-\varsigma'}},$$

where $\bar{s}_{j,\tau}^{i} = \frac{s_{j,\tau}^{i} + s_{j,\varsigma}^{i}}{2}$. Second, labor reallocation convergence during ς to τ $(LRC_{\varsigma-\tau})$ is decomposed as:

$$LRC_{\varsigma-\tau} = \underbrace{\sum_{j=1}^{J} \overline{\left(\frac{y_{j,\tau}^{i}}{y_\tau^{US}}\right)}\Delta_{\varsigma'-\tau}s_{j,\tau}^{i} - \sum_{j=1}^{J} \overline{\left(\frac{y_{j,\tau}^{US}}{y_\tau^{US}}\right)}\Delta_{\varsigma'-\tau}s_{j,\tau}^{US}}_{LRC_{\varsigma'-\tau}} + \underbrace{\sum_{j=1}^{J} \overline{\left(\frac{y_{j,\tau}^{i}}{y_\tau^{US}}\right)}\Delta_{\varsigma-\varsigma'}s_{j,\varsigma'}^{i} - \sum_{j=1}^{J} \overline{\left(\frac{y_{j,\tau}^{US}}{y_\tau^{US}}\right)}\Delta_{\varsigma-\varsigma'}s_{j,\varsigma'}^{US}}_{LRC_{\varsigma-\varsigma'}},$$

where $\overline{\left(\frac{y_{j,\tau}^{i}}{y_\tau^{US}}\right)} = \frac{1}{2}\left(\frac{y_{j,\tau}^{i}}{y_\tau^{US}} + \frac{y_{j,\varsigma}^{i}}{y_\varsigma^{US}}\right)$. Finally, between-sector convergence during ς and τ $(BSC_{\varsigma-\tau})$ is decomposed as:

$$BSC_{\varsigma-\tau} = \underbrace{\sum_{j=1}^{J} (\bar{s}_{j,\tau}^{i} - \bar{s}_{j,\tau}^{US})\Delta_{\varsigma'-\tau}\left(\frac{y_{j,\tau}^{US}}{y_\tau^{US}}\right)}_{BSC_{\varsigma'-\tau}} + \underbrace{\sum_{j=1}^{J} (\bar{s}_{j,\tau}^{i} - \bar{s}_{j,\tau}^{US})\Delta_{\varsigma-\varsigma'}\left(\frac{y_{j,\varsigma'}^{US}}{y_{\varsigma'}^{US}}\right)}_{BSC_{\varsigma-\varsigma'}}.$$

3 Quantitative Analysis

3.1 The Source Data

3.1.1 Preamble

Our framework combines a top-down approach with a bottom up approach. The former features a nested development accounting exercise that requires macroeconomic data while

the latter performs a convergence accounting exercise that rests on sectoral data. For the sake of accuracy, the two source data should entertain a minimum level of consistency ranging from the need to maintain the same coverage of countries to other important considerations that touch on coherence between concepts. Both source data provide series on production and employment, therefore it is important to ensure whether they add up and whether they comply with the notion of 'fitness for use'—the adequacy of the series for its intended use. We begin with the description of the source data and then move on to the analysis of their coherence.

The natural source data for the top-down approach is represented by the Penn World Tables (PWT), a rich panel data set of a wide range of countries over a long time span typically designed to facilitate cross comparisons of living standards and their proximate sources. The eighth vintage of the PWT (PWT8.0), maintained by the GGDC, features several upgrades in terms concepts, methods, and source data, while it also expanded the set of variables required by a nested development accounting exercise.[2] Feenstra et al. (2015) discuss some of the long-standing issues traditionally experienced by the PWT along with the new and enhanced underpinnings of its eighth vintage, while Harchaoui (2015) formally tests the superiority of the PWT8.0 in terms of accuracy over the preceding vintages.

While the PWT8.0 represents a major leap forward both in terms of enhanced reliability of macroeconomic data and coverage of much of the 49 countries that officially constitute SSA, its equivalent at the sectoral level remains scanty. For example, the WDI, which covers most of the 49 SSA countries, offers value added in current and constant U.S. dollars for agriculture, industry and services for some years. However, these series are not offered in international PPPs, nor does this source data provide the corresponding long and continuous employment time-series that are necessary to compute coherent labor productivity trends and levels. Longer series for labor productivity are deemed important for the delineation of broad patterns of economic growth and development.

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[2]http://www.rug.nl/research/ggdc/data/pwt/pwt-8.0

The recently developed Africa Sectoral Database (ASD), also maintained by the GGDC, offers several attractive features over the WDI.[3] The ASD is a panel dataset that provides information on valued added (in current and constant 2005 prices expressed in national currencies) and employment for ten main sectors using the International Standard Industrial Classification, Revision 3.1.[4] The ASD offers two important advantages: First, it includes sector-specific PPPs for the 2005 benchmark year that facilitate the construction of reliable sectoral measures of productivity levels. Second, its consistency both in terms of sectoral delineation and concepts to the 10-Sector Database (also maintained by the GGDC) facilitates data integration, such as the use of information on the U.S. economy and its constituent sectors used as a benchmark.[5] The consistency and reliability of this source data comes, however, at the cost of a reduced coverage, represented by a set of only 11 countries out of 49 countries, which officially represent the SSA region. Despite this smaller coverage in terms of countries, the ASD remains representative both in terms of relative size, which is close to 70% of nominal GDP, and in terms of the breadth of countries that fall under the World Bank country classification.[6]

3.1.2 Coverage and Data Series

Given the difference in the country coverage between the two source data, we brought the number of countries to its lowest common denominator represented by 11 countries of the ASD. All in all, the PWT8.0 and the ASD used in this paper include 11 SSA countries which are not covered consistently over time across the two datasets. While these 11 countries

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[3]http://www.rug.nl/research/ggdc/data/africa-sector-database

[4]These sectors are: (1) agriculture, (2) mining, (3) manufacturing, (4) utilities, (5) construction, (6) trade services, (7) transport services, (8) business services, (9) government services, and (10) personal services. Data for dwellings is presented separately for the purpose of productivity analysis, since this imputed production does not have an employment equivalent. We exclude it for the purpose of sectoral productivity comparisons.

[5]http://www.rug.nl/research/ggdc/data/10-sector-database

[6]This classification, based on the GNI per capita in US$ (the World Bank Atlas method) of the year 2010, offers the following brackets: low-income-economies$\leq$\$1,005 (Ethiopia, Kenya, Malawi, and Tanzania); \$1,006<lower-middle income economies<\$3,975 (Ghana, Nigeria, Senegal, and Zambia); and \$3,976<upper-middle-income-economies<\$12,275 (Botswana, Mauritius, and South Africa). See https://datahelpdesk.worldbank.org/knowledgebase/articles/378834-how-does-the-world-bank-classify-countries.

are consistently covered by the PWT8.0 since 1960 onwards, for many countries in the ASD—including Botswana, Kenya, Malawi, Mauritius and Senegal—the coverage starts at a later stage. As a result, we truncated the time period from 1960-2010 to 1970-2010, which still covers the most interesting episodes of the SSA economies such as the lost decades and the recent growth spurt periods. We believe that the earlier 1960-1970 is primarily a transition period following the independence of the majority of the countries covered and, thus, constitutes the least interesting episode from the perspective of the development path of the SSA economy.[7]

With this sample of countries consistently maintained across the two source data, we considered the following set of variables for the implementation of our framework. From the PWT8.0, we retained the variable $RGDP^e$ (in US$ 2005), a measure of final demand real GDP at chained PPPs suitable for cross-country as well as over time comparisons. In combination with the population series, we computed real GDP per person. Labor is measured in terms of persons engaged in production, a concept that covers employees, self-employees, and unpaid family workers. The human capital index is constructed from the combination of returns to schooling and years of schooling, while capital input is measured in terms of real capital stock in PPPs (US$ 2005) and covers machinery and equipment and structures (buildings and engineering). Labor income share data which reflect both labor compensation of employees and mixed income of the self-employed varies across countries and over time.

Not all the variables required by the implementation of the development accounting are available. For example, the information required for the compilation of the employment rate for those in the 15-64 age group was obtained from the WDI. Similarly, not all the information related to human capital and labor share was available for all of the 11 countries of our sample and, as a result, they had to be imputed from the closest donor—a widely used technique in official statistics (see Berlin and Song, 2015).

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[7]Bates et al. (2007) refer to this episode as "the post-imperial 'lost decades'". Kenya, Malawi, Botswana, Mauritius became independent in 1963, 1964, 1966, 1968, respectively.

The ASD has been subject to two changes. First, sectors of government services and personal services had to be collapsed into one sector as the employment series for Zambia do not offer this breakdown, while owner-occupied dwellings have been dropped due to the absence of employment data. Second, the constant-price value added series expressed in national currencies have been converted to dollars using the 2005 PPPs supplied as part of the ASD. A complete series on real value added in international prices has been extrapolated forward and backward using the growth rates of real value added by sector. We follow this approach for each sector and country over the 1970-2010 period.

Aggregate employment and value added (in current and constant PPP-adjusted) series were derived from the straight sum of annual levels across sectors for each SSA country. These national series were, in turn, aggregated across all SSA countries to arrive at the SSA 'bloc'. The same procedure has been followed for the U.S. Labor productivity in each sector of the SSA and the U.S. economies is computed as the ratio of each sector's PPP-adjusted real value added by the corresponding level of sectoral employment. Our aggregating procedure is, thus, different from the one used by McMillan et al. (2014) and de Vries et al. (2015) which do not resort to sectoral or national weights. While our approach tends to give more weight to larger sectors within a given economy and to larger economies across the SSA sample, it remains a well-established practice in the area of economic measurement (see OECD, 2001). Another important reason in favour of using weighted aggregates is motivated by the need to reduce the impact of volatility that may arise from small economies or from those which experienced a rapid growth from a low level. Our sample of SSA economies comprises many poor countries which feature a high degree of specialization in few and highly volatile sectors. Moreover, the lack of diversification of these economies makes them prone to severe macroeconomic shocks which reinforce idiosyncratic shocks (see Koren and Tenreyro, 2007). Our approach, thus, has the merit to place the emphasis on long-terms paths free from any wild volatility that the sample of SSA economies is generally subject to.[8]

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[8]Although McMillan et al. (2014) carried out the decomposition of aggregate labor productivity under both unweighted and weighted figures, their story remained consistent for Africa: the "within" effect

3.1.3 Reconciliation and Data Quality Issues

A cross-country exercise such as the one we conduct in this paper, based on a variety of disparate source data, raises necessarily the issue of reliability and reconciliation. Several studies have called into question the state of Africa's official statistics while others have emphasized the major upgrades initiated by their U.S. counterparts.[9] This represents a major source of uncertainty on whether the catch-up, stagnation, or falling behind of the SSA economy represents a genuine phenomenon, reflecting pure economic performance differences, or is the result of a figment in the data.

While answering this question is beyond the scope of this paper, we nonetheless tackle head on the extent to which the data series available accurately track the important issue of informality. This problem is particularly acute for the SSA economy where there are crying deficits in what official statisticians would refer to as core infrastructure statistics. For example, the deficiencies in some basic data collection programs (e.g., establishments engaged in the informal activities generally missing from survey frames) are magnified by the absence of an integrated set of economic accounts that make it difficult to use alternate measures of GDP to track possible signs of 'non-observed' economy.[10]

The aggregate GDP and employment series available from the PWT8.0 and the ASD constitute a compelling case in point. According to de Vries et al. (2015), employment series from the ASD are based on the population census, admittedly an adequate vehicle to track informal activities. This contrasts with the series from the PWT8.0 which are taken from labor force surveys, making them prone to under coverage due to inadequate frames. On the output side, both the ASD and the PWT8.0 use different measures of GDP—the

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constitutes a productivity-enhancing factor while "structural change" remained growth-reducing.

[9]See Devarajan (2013) for Africa and Harchaoui (2016) for the U.S., including the literature cited therein.

[10]The typical approach is to compare the difference between the expenditure side and the income side of GDP. These two measures entertain a legitimate statistical discrepancy (particularly due to measurement differences) that is expected to remain reasonably small. A larger discrepancy over time is taken as a sign of a non-observed economy. For example, if the income side is getting increasingly larger than the expenditure side, this can be interpreted as an indication that net purchases have been made in the non-observed economy while the reverse suggests that the non-observed economy has generated net income. See OECD (2002) on the whole issue of non-observed economy.

value-added (gross output net of intermediate purchases) approach for the former and the final expenditures approach for the latter—each of which remains tainted to varying degrees with issues related to the non-measurement economy. There is, though, a general consensus amongst official statisticians that both value added and income approaches to GDP are less adequate than their expenditure counterpart in tracking non-measured economy (see Eurostat 2013, Chapter 6).[11]

Non-measurement activities, pervasive in retail, construction, food and accommodation, etc., generally take the form of under-reporting revenues (an important component of gross output) and/or over-reporting costs in an attempt to understate profits (an important component of value added). While the sales, costs, or income related to these activities are very likely missing, they can be tracked by an adequate household spending survey which a number of the SSA economies possess. The latter is, in turn, benchmarked to the census. Government spending, which is also part of the final demand GDP, are adequately tracked due to the need for the government—and the International Monetary Fund (IMF)— to accurately monitor the fiscal situation. The other two components—investment and net exports—are perhaps the less problematic: investment is generally the fact of large corporations and/or government engaged in core activities and not informality, while trade data can be ascertained through the principle of reciprocity in bilateral trade data.

While our review of the conceptual underpinnings seem to favour ASD for the employment series and the PWT8.0 for the GDP series, this begs the question on whether they capture some obvious episodes such as the well-documented slump period from the mid-1980s to the early 1990s, and the surge period that started at the turn of the millennium and whether they offer a consistent story about the SSA-U.S. gap.[12] Both of the ASD employment series and PWT8.0 GDP series stand the test of reality check, thereby lending support to their

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[11]Note also that the final demand GDP uses a different set of PPPs than the sectoral value added. The discrepancy that may arise from this different method is mitigated by the benefit offered by the final demand GDP in tracking more accurately informality.

[12]In their examination of the political-economy approach to the IMF's lending decisions (both stabilization and structural programs) for the period 1970-2000, Barro and Lee (2005) found that the loan programs of this institution have generally had a depressing effect on economic growth.

conceptual superiority (see Figure A1 and Figure A2 in the Appendix).

The ASD employment series reflect the big slump experienced by the SSA from the mid-1980s until the early 1990s and the important recovery that emerged during the following period. Similarly, they report a lack of convergence to the U.S. level for most of the historical period until the recent surge period. This contrasts markedly with the PWT8.0 employment series which wiped out the slump period and report an unlikely steady movement of convergence to the U.S. level. In contrast, this slump period is captured by a drop in the expenditures approach to GDP, while it does not appear in its value added counterpart of the ASD. In terms of the relative gap, the final expenditure approach to GDP shows a long period of a falling behind of the SSA economy that picked up rapidly in the late decade, both of which are features that the value added measure has downplayed.

The main take away point out of this review is that: 1) The employment series available from the ASD and the final demand GDP available from the PWT8.0 appear to track more accurately the issue of informality. As a result, this employment series will be employed in both the aggregate and sectoral approaches of the present work. 2) While GDP series from the PWT8.0 offer less uncertainty, compared to the value added series from ASD, the latter will be considered as providing a lower bound in the assessment of the SSA economic performance, which means that some of the gaps observable at the sectoral level are possibly tinted with measurement errors that arise from informality.

3.2 Aggregate Analysis

3.2.1 GDP per Capita and Its Components

Plotted on a log scale for the 1970-2010 period, the most striking fact displayed in Figure 1 is the steady advance of U.S. real GDP per capita. While the growth rate slowed during the 1990-2010 period compared to the 1970-1990 period (1.4% vs. 2.2%), the overall period advanced annually at 1.8% per year, a rate sufficient to double the standard of living every 38 years. In the SSA, the average growth rate between 1970 and 2010 is a lackluster 0.5%

annual growth, reflecting an erratic advance compared to the U.S. (-1.2% during the early two decades compared to 2.2% during the subsequent two decades). The SSA fell steadily behind the U.S. through the late 1980s then suffered downward dislocations associated with the period of structural adjustment that started in the mid-1980s and continued until the early 1990s. These periods which were at the core of SSA's lost decades were followed by a reversal that only translate into a marginal catch-up during the period that began in the second half of the 1990s.
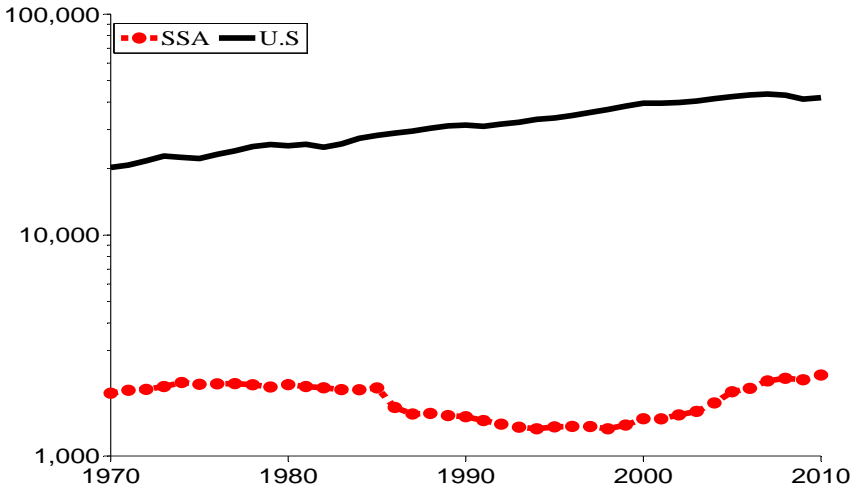

Figure 1: GDP per capita (Log scale)

The equivalent record for labor productivity is displayed in Figure 2. The U.S. record of productivity growth is not as steady as that for output per-capita and displays its strongest performance during the 1990-2010 period (1.8% compared to 1.3% during 1970-1990). The SSA record on productivity in Figure 2 closely mirrors that for output per capita in Figure 1. The SSA starts out well below the U.S. in 1970, experiences a 1% average decline in its productivity performance during the 1970-1990 period but then, with a sharp 2.2% spurt during 1990-2010, recovers all of the lost ground during the 1980s.

The data in Figures 1 and 2 can be combined as in Figure 3 which plots the ratios of the SSA to the U.S. levels of output per capita and the factors that underlie its change– labor productivity, employment rate, and demographic dividend. This graphical format

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dramatizes several themes that are less obvious in Figures 1 and 2. The SSA/U.S. ratio of GDP per capita declines steadily from almost 10% in the early 1970s to 5% in the mid-1980s, with sharp structural adjustment-related jolts taking the ratio down to its minimum of 3.6% in 1998. The upsurge from 2000 to 2010 brings the ratio back to 5.6%, barely above the pre-structural adjustment level.
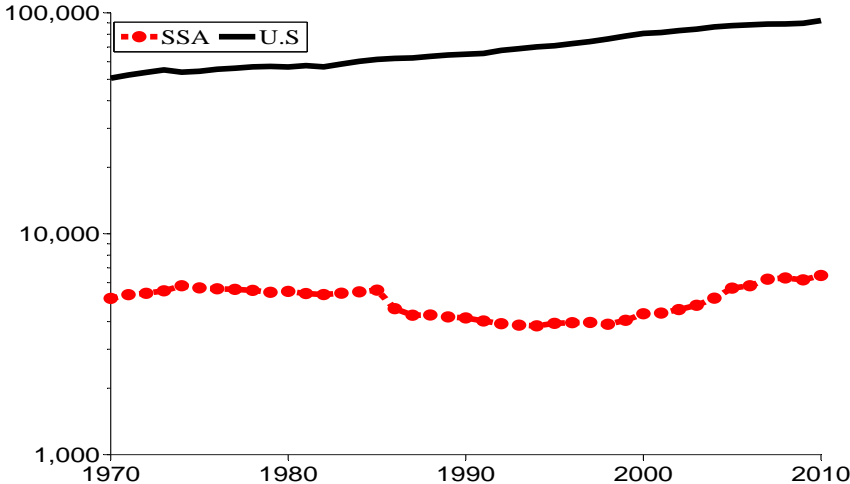
Figure 2: Labor productivity (Log scale)

The SSA/U.S. ratio for productivity level in Figure 3 exhibits the same downward slide at about the same rate from about 10% during the 1970s and early 1980s to a little less than 7% in the late 1980s. Throughout the subinterval 1990-2000, the productivity ratio continued its slide and reversed only during the new millennium. During the entire historical period, labor productivity remained slightly above that of GDP per person, indicating that the SSA had a level of employment per capita close to that of the U.S. and a more favorable demographic dividend, both of which though were not large enough to compensate for the relatively poor performance of labor productivity.

Much of the fascinating details of Figures 1-3 are lost in a table that presents growth rates solely for the SSA, such as Table A2 in the Appendix. The table shows SSA's GDP per capita experienced a major turnaround in the 1990s, particularly over the 1998-2010 period. Without information on the relative performance, simple growth rates can be misleading.

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However, when accompanied by the levels and ratios of Figures 1 to 3, the growth rates in Table A2 are a useful complement. They quantify two aspects of the graphical data. First, after one-quarter of a century of falling behind the U.S. level of real income per capita and productivity, since 1998, the SSA has not been catching up. Real income per capita over 1998-2010 in the SSA grew at a 4.8% average, compared to 1% for the U.S. (4.3% vs. 1.6% for labor productivity), and this advance caused the relative level of the SSA real income per capita to reach 5.6% in 2010 from a low level of 3.6% in 1998. Second, and more importantly, although this recovery was remarkable by historical standards, it only recovered one-third of the six percentage points of (relative) real per capita income lost during the 1970-1998 period.
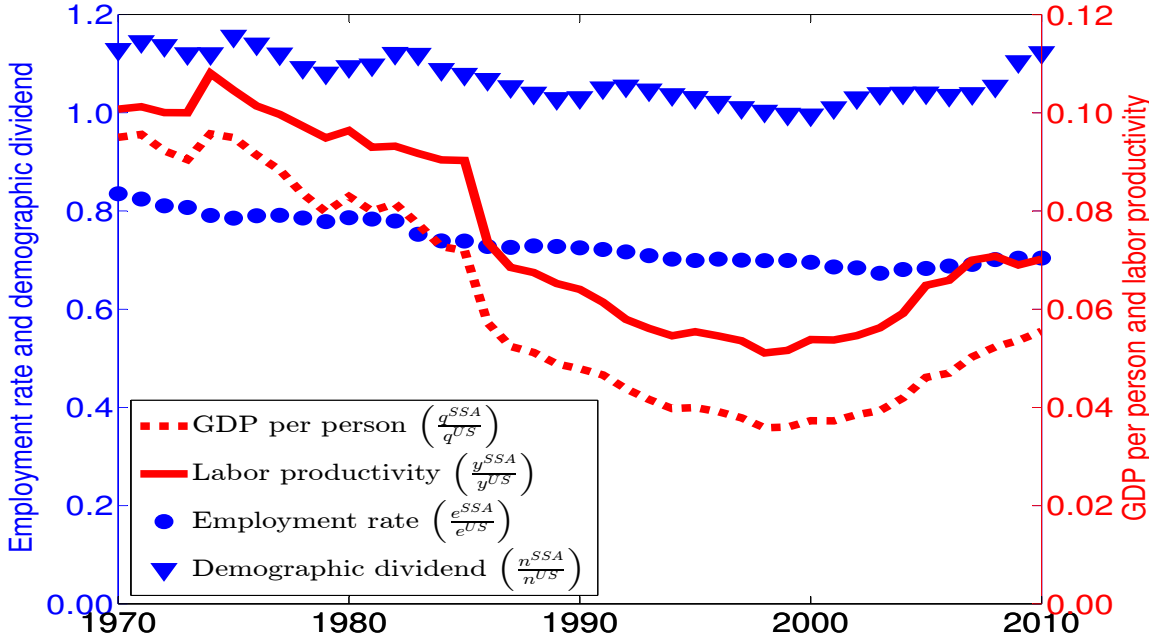

Figure 3: GDP per person and its sources in the SSA, 1970-2010 (relative to the U.S.)

In Figure 4, the SSA/U.S. ratio of output per capita is divided by the SSA/U.S. ratio of output per employee, and this shows a decline from 94% in 1970 to 79% in 2010. By definition, any changes in this ratio must be completely explained by changes in the same direction in the product of labor market activity and demographic dividends. Both of these

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ratios contributed to the divergent behavior of real per capita income to productivity. The labor market activity accounted for 60% in the steady decline in the SSA relative ratio of real per capita income to labor productivity during the 1970-1998 period (-1.05% annual average). The surge experienced by this ratio during the subsequent period (+1.0%) was virtually the result solely of the demographic dividend.
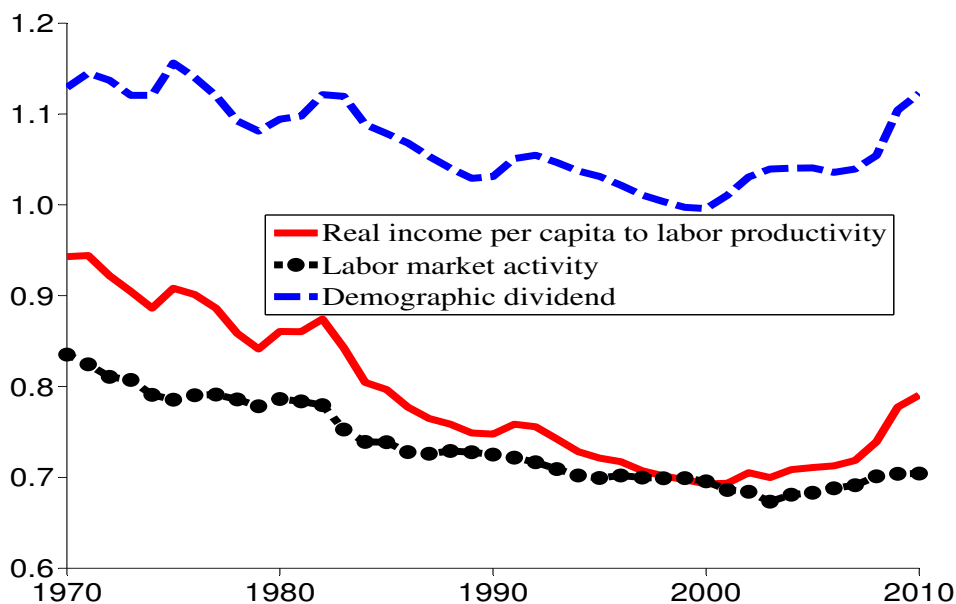

Figure 4: Sources of change of the ratio of real income per capita to labor productivity in the SSA, 1970-2010 (relative to the U.S.)

3.2.2 Labor Productivity and Its Components

Human Capital. Cross country differences in human capital contribute to cross-sectional gaps in output per worker. This result is not controversial and has been consistently corroborated by a large body of the development accounting literature. The comprehensive survey, put together by Caselli (2005), along with many other subsequent studies, highlighted the central role of human capital and provided the motivation for developing countries to invest in this form of capital to enhance the quality of their workforce.

The emphasis placed by national and international development policies on education at-

tainment (e.g., years of schooling, enrollment rates, and completion rates) in recent decades has mirrored the widespread use of this measure in the development literature. The SSA spends hundreds of billions of dollars each year on schools, educational materials, and teachers. These spendings have doubled in constant prices from 1980 to 2010 and contributed to closing the gap with the U.S. in terms of education attainment by the end of the 1970-2010 period. This performance is corroborated with our measure of human capital (Figure 5) which shows that, in 2010, the SSA represents 85% of the U.S. level, up from 52% in 1970.
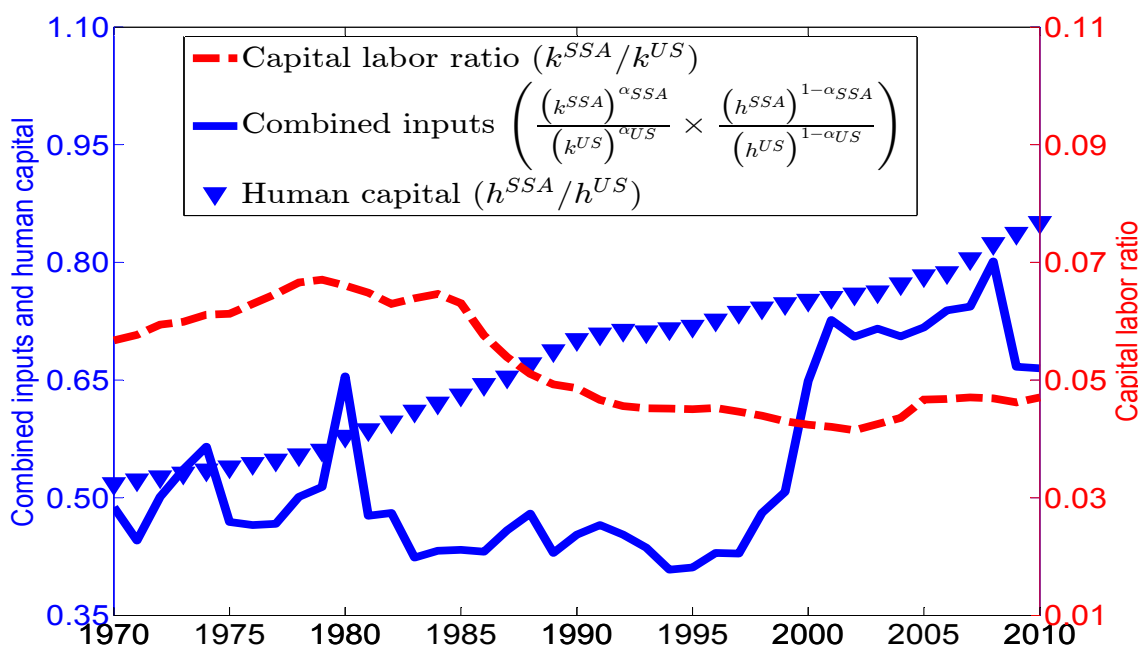

Figure 5: Human and tangible capital in the SSA, 1970-2010 (relative to the U.S.)

While the SSA's progress in terms of education attainment looks remarkable, it begs the question as to why the SSA had such a poor relative productivity performance given its convergence to the U.S. human capital level. As emphasized by Hanushek and Woessmann (2012) in their study of Latin America, a large part of this conundrum can be explained by the fact that education attainment tracks the time spent at school and not how much students are gaining in terms of learning and skills.[13]

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[13]In their comprehensive survey of the literature, Hanushek and Woessmann (2008, p. 608) summarize

Following this paradigm shift, a large body of the development accounting literature has recently started to employ comparable international tests of mathematics, science, and reading to make the concept of human capital track more closely cognitive skills of the workforce. Mounting evidence based on the use of cognitive skills has revealed that little closing of the gaps between developed and developing nations has effectively occurred. For example, Cubas et al. (forthcoming), in their model of an economy with heterogeneous forms of labor with endogenous skills, found that cross-country labor quality differences based on cognitive skills are twice as large as those based on conventional measures, suggesting a more modest order magnitude for TFP in the cross country gap of real output per worker. A similar result has been reached by Erosa et al. (2010) using a different modeling strategy; and by Caselli (2015) employing a development accounting exercise for Latin American economies.

What is the story for the SSA? Between 1964 and recent years, international agencies developed and implemented close to 50 different international student achievement tests in math, science, or reading on 14 separate international testing occasions (several of which tested more than one subject and age level). The existing data from worldwide student achievement tests, organized on a consistent basis by Hanushek and Wößmann (2007), comprise a wide-range of countries at a different level of economic development. Out of the sample of eleven SSA countries considered in the present paper, only a few have ever participated in any of the international student achievement tests (Botswana, Ghana, Malawi, Nigeria, and South Africa).

The general pattern of these data suggest that these countries reported a performance uniformly below the threshold of 400 test-score points–a rough indication of basic literacy in mathematics and science. Not only SSA's students do not achieve a level of basic literacy in cognitive skills but the results from one panel of the achievements test to another reveal

the current state of play as follows: *"Most people would, in casual conversation, acknowledge that a year of schooling in a school in a Brazilian Amazon village was not the same as a year of schooling in a school in Belgium. They would also agree that families, peers, and others contribute to education. Yet, the vast majority of research on the economic impact of schools–largely due to expedience–ignores both of these issues. The data suggest that the casual conversation based on disparities in school attainment may actually understate the magnitude of differences in true education and skills across countries."*

that the performance has consistently deteriorated over the years.[14]

While we understand that the underlying sample size is small which makes the estimates subject to a great deal of uncertainty, the results have therefore to be considered as only indicative of a severe data gap that needs to be addressed rather than a definitive assessment on the status of skills in SSA. With all these cautionary remarks in mind, Figure 6 tells nonetheless a fascinating tale. The results on achievement tests reverse the optimistic tone conveyed by the conventional measure of human capital measured in terms of education attainment. Assuming that this reversal is genuine, then the prospect of SSA development would look bleaker than initially thought given that human capital gaps are considered by the development economics profession as persistent and the hardest to bridge.[15]
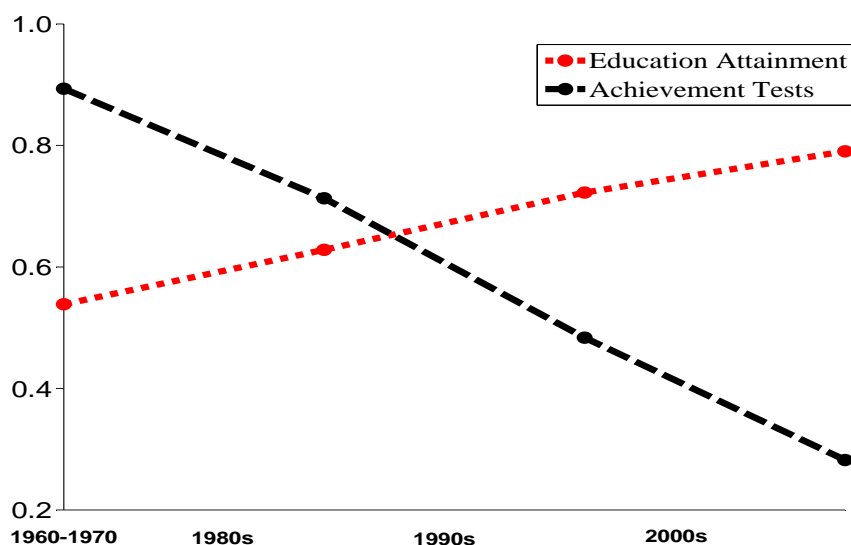

Figure 6: Human capital in the SSA, 1960-2010 (relative to the U.S.)

Capital-Labor Endowments and TFP. In 1970, the SSA's relative capital-labor ratio

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[14]Though considerably low in absolute terms, these results perhaps need to be considered as the upper bound given the Hanushek and Woessman (2008, p. 653) assessment "*that the group of developing countries participating in the international tests is probably already a select sample from all developing countries, and, furthermore, the children enrolled in school at the different testing grades are probably only a select group of all children of the respective age in these countries.*"

[15]A similar diagnosis has been reached by McKinsey (2010, p. 20) for Africa:"*There is mounting evidence from surveys in Africa and in other developing countries that basic skills in reading and mathematics remain low. In some African countries, student test scores have stagnated or even declined [...]. In a South African survey, just 37 percent of respondents correctly answered more than half of 'real-life' math questions (e.g., A shop has 126 liters of milk. 87 liters are sold. How many liters remain?).*"

was only 5.7%, reflecting the state of an economy at the initial stage of economic development with a modest endowment of capital (see Figure 5). During most of the 1970s, the ratio advanced more rapidly relative to its U.S. counterpart, reaching a historical peak in 1979 at 6.7% before entering a long period of deterioration that halted in 2002 when the ratio reached a 4.1% trough. The 0.6 percentage point gained during the subsequent period recovered just less than one-quarter of the 2.6 percentage points lost between 1979 and 2002.
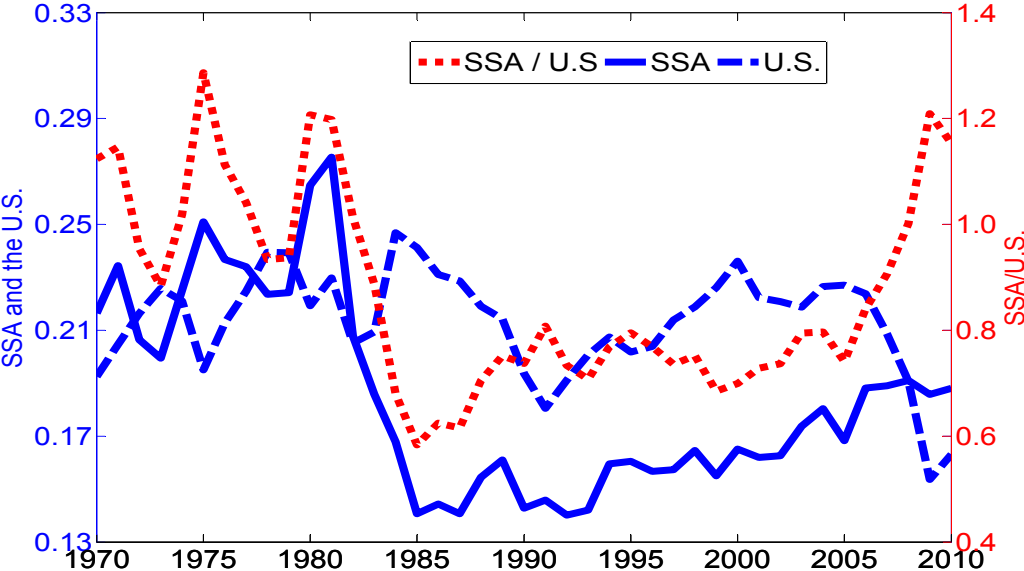

Figure 7: SSA and U.S. investment to GDP ratios at current PPPs

The development path of the SSA's relative capital-labor ratio mirrors that of its investment to GDP ratio which UNCTAD (2014), in its recent comprehensive report on the state of capital formation in Africa, considers as depriving the African economy of the tools, facilities, and infrastructures that would leverage the existing labor force to maintain a sustained growth. For example, during the 1970-1981 period, SSA spent 23 cents (in international prices) for every dollar spent by the whole economy in final goods and services, compared to 22 cents for the U.S. (see Figure 7). During the subsequent decades that ended in 2006, while the U.S. investment spending remained at the same proportion, its SSA counterpart dropped sharply to roughly 16%. The sharp revival in the SSA relative investment to GDP

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ratio results more from the major effect of the Great Recession on the U.S. economy than from any kind of the SSA exceptionalism.

We now have reached the stage where we can bring all the pieces together to quantify the apportionment of the relative gap in labor productivity between a broad notion of capital (capital deepening combined with human capital) and TFP. SSA economy produced about one tenth of the output per worker of the U.S. during the early 1970s then dwindled precipitously to one twentieth around the mid-1990s (see Figure 8). The growth spurt that occurred during the first decade of the new millennium caused the level of SSA labor productivity to recover only two-fifths of the gains lost during the two decades that followed the mid-1970s.
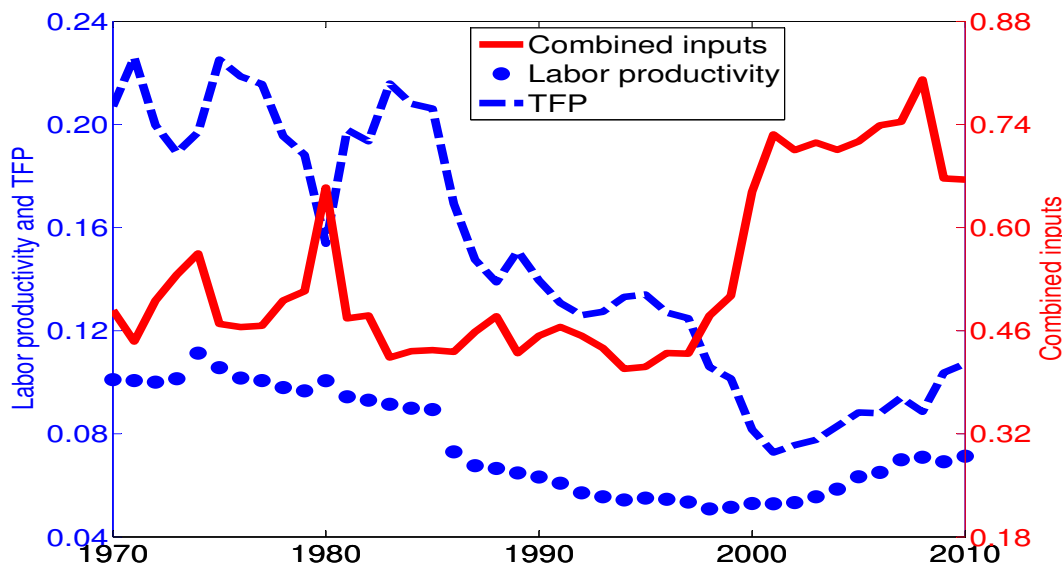

Figure 8: Sources of labor productivity gap in the SSA, 1970-2010 (relative to the U.S.)

The analysis of the sources of labor productivity gap reported in Figure 9 recounts the following interesting tale. First, under the conventional measure of human capital, TFP dwarfs factor input endowments with a 90% contribution to the relative labour productivity gap during the 2000s, up from around 70% during the 1960-1990 period. This implies that TFP problems in the SSA economy are so severe that they make factor endowments of second-order importance. Second, under the alternate measure of human capital, a steady

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and significant decline over time in the contribution of TFP is emphasized, from 66% in the 1960-1970s down to 49% in the 2000s. This finding suggests that gaps resulting from cognitive skills have severely worsened off over time to the point of making the TFP residual no longer the biggest part of the story underlying relative labor productivity differences. While SSA appears to suffer in the recent decade from an efficiency gap as much as it suffers from factor endowments gap, TFP problems remain stubbornly important.
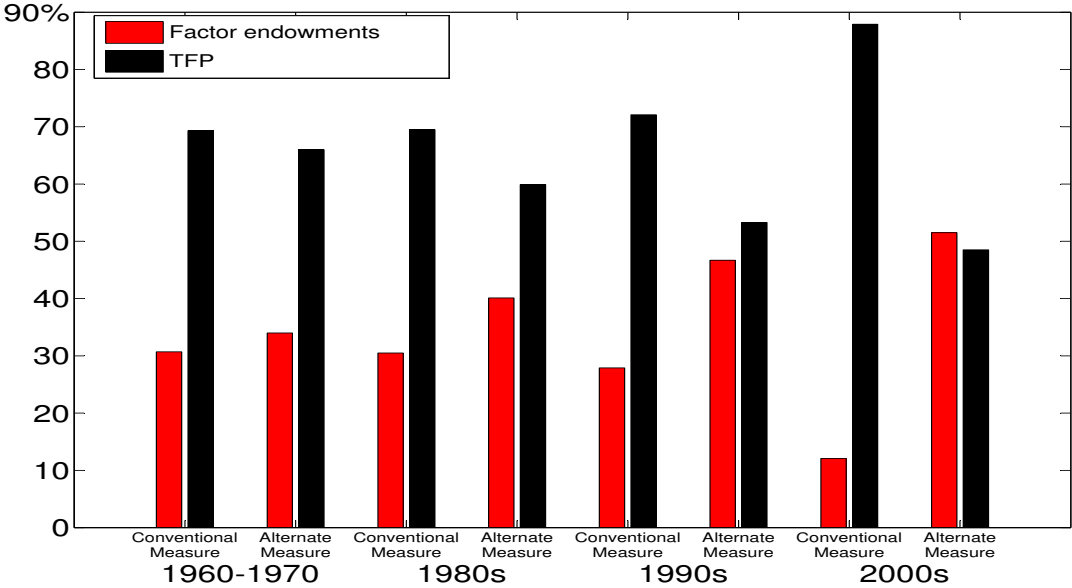

Figure 9: Contributions of factor endowments and TFP to relative productivity gap of the SSA economy under the conventional and alternate measures of human capital (percentages)

What accounts for these differences in relative TFP? While answering this question remains beyond the scope of this paper, a recent strand of literature emphasized the presence of important sources of distortions in developing nations (see Restuccia and Rogerson, 2008). SSA economy has not been spared by this adverse effect. Ramachandran et al. (2009) provided ample evidence that the SSA economy is subject to a burdensome regulation that considerably impedes the cost of doing business. The quantitative impact of this business environment has been found by Bah and Fang (2015) as being responsible for almost half of the SSA relative labor productivity gap which suggests that the creation of an attractive

business environment offers the potential to unleash significant productivity gains for the SSA economy. Assuming hypothetically that distortions is the story, it is important to understand whether their impact is broad-based affecting the whole economy or idiosyncratic, sector-specific. This question is taken up by the next section which revolves around sectoral labor productivity convergence.

3.3   Sectoral Analysis

3.3.1   Broad Patterns

We now move to the bottom up of our quantitative analysis to examine whether there are any indications of sectoral convergence. Our analysis reiterates some important regularities highlighted by Harchaoui and Üngör (2015) at a finer level of resolution at the country level, while others are novel. Table 1 shows that employment share in agriculture in the U.S. was less than 2% in 2010. This sector remains, in 2010, the primary employer in the SSA economy, accounting for almost 60% of the workforce, down from about 71% in 1970. These ten percentage points decline over a four-decade period pale, however, when compared to Asia which achieved this performance for almost each of the decade that spanned the 1970-2010 period.[16] Market services represent the primary destination sectors of the deployed labor of the SSA economy. Manufacturing which, under typical circumstances, has much greater potential to absorb the 'surplus' labor deployed away from agriculture, has been by-passed along this process of structural transformation. SSA's pattern, thus, stands in a sharp contrast with that of Asia where manufacturing hosted almost one-fifth of the 30 percentage points of employment deployed away from agriculture during this period.[17]

Another feature of SSA's structural transformation is the large intersectoral productivity gaps, indicative of advances in allocative efficiencies that reduce overall labor productivity.

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[16]Asia covers China, India, Japan, South Korea, Taiwan, and Thailand. The estimates are constructed from the 10-Sector Database.

[17]Shifa (2015) notes that the kind of low-skill manufacturing growth experienced by the East Asian countries did not happen, despite the availability of a vast and cheap labor force, in SSA.

In 2010, the most efficient SSA sector shows a level of productivity 98 times higher than the least efficient one, compared to only about 7 times for the U.S. While this represents a significant advance compared to the 236 times order of magnitude difference reported in 1970 by the SSA economy (21.6 for the U.S.), the SSA still fits, to a large extent, the dual economy model à la Arthur Lewis (see Lewis, 1954; Gollin, 2014).

Table 1: Sectoral data, SSA versus U.S., 1970-2010

					Panel A. Employment shares (%)					
Country	Agriculture	Mining	Manufacturing	Utilities	Construction	Trade	Transport	Business	Non-market	Whole Economy
SSA										
1970	70.6	1.4	8.3	0.2	1.5	9.4	1.3	0.5	6.6	100.0
1990	70.3	1.3	7.4	0.3	1.4	9.3	1.4	1.0	7.6	100.0
2010	58.3	0.6	6.6	0.3	2.7	15.7	2.5	2.4	11.0	100.0
US										
1970	3.2	0.7	22.2	0.7	5.3	21.0	6.0	9.2	31.7	100.0
1990	2.0	0.6	15.2	0.6	5.6	24.1	4.6	15.5	31.8	100.0
2010	1.5	0.5	8.7	0.4	5.1	24.1	4.0	18.1	37.6	100.0
					Panel B. Labor productivity (in PPPs) (in thousands)					
Country	Agriculture	Mining	Manufacturing	Utilities	Construction	Trade	Transport	Business	Non-market	Whole Economy
SSA										
1970	0.6	42.1	4.3	17.2	17.0	3.7	9.8	134.4	9.7	3.5
1990	0.5	42.4	5.8	22.2	13.1	4.1	11.0	104.4	11.1	4.0
2010	0.7	68.5	6.3	22.9	11.5	3.7	10.9	70.0	9.1	5.2
US										
1970	15.5	334.9	30.5	172.6	106.0	26.1	36.0	145.6	60.1	56.6
1990	29.4	301.2	53.7	251.6	79.5	32.7	63.1	130.9	60.3	66.7
2010	68.3	372.7	108.3	360.1	54.3	54.9	113.0	166.3	57.3	85.9
					Panel C. Labor productivity, relative to the U.S. (%)					
Country	Agriculture	Mining	Manufacturing	Utilities	Construction	Trade	Transport	Business	Non-market	Whole Economy
SSA										
1970	3.7	12.6	14.0	10.0	16.0	14.1	27.1	92.3	16.1	6.1
1990	1.6	14.1	10.7	8.8	16.4	12.6	17.5	79.8	18.3	6.0
2010	1.0	18.4	5.8	6.4	21.2	6.8	9.7	42.1	16.0	6.0

Note: Aggregate labor productivity of country i at time t constitutes a weighted sum of the sectoral productivity levels, $y_t^i = \sum_{j=1}^{J} s_{j,t}^i y_{j,t}^i$, with $s_{j,t}^i$ representing the share of employment of sector j in the overall economy.

3.3.2 Sectoral Sources of Convergence

We now cast these rich and contrasting sectoral considerations into a unifying framework represented by Equation (6) to quantify the sources of the aggregate productivity convergence. Figure 10 quantifies how much of the convergence in the aggregate productivity is

attributable to the within-, reallocation- and between- effects during the 1970-2010 period and its two sub-periods 1970-1990 and 1990-2010.
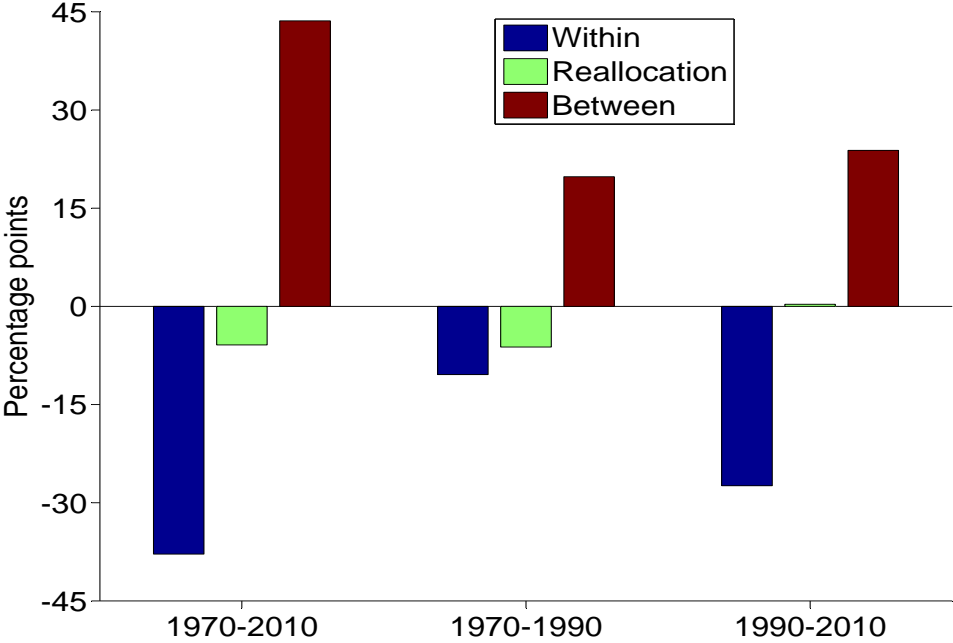

Figure 10: Sources of convergence of the SSA to the U.S. labor productivity level (percentage points)

The lack of convergence of the SSA economy to the U.S. level documented earlier results from two conflicting effects: The within- and, to a lesser extent, the reallocation-effects pulled the performance of the SSA economy away from the world frontier. With a -38 percentage points contribution, the within-effects suggest that both capital deepening and/or TFP contributed to the shortfall in the SSA convergence. The effects of structural transformation, albeit small, are negative suggesting a deployment of labor towards sectors reporting a productivity gap, an indication that SSA's structural transformation works backward—away from and towards low-productivity sectors. The positive contribution of the reallocation-effect reflects the advance made by the SSA in the allocative efficiency. Out of the three effects considered, it represents the only good news which contributed to wipe out all of the negative impacts of within- and reallocation-effects. Considered together, these results

suggest the absence of bold fundamentals behind SSA's growth spurt.

The analysis performed over a four-decade time span can legitimately be regarded as being unfair to the efforts deployed by the SSA prior the turn of the 21st century which reduced armed conflicts, enhanced macroeconomic conditions, and initiated economic reforms meant to energize markets. These efforts, combined with favourable global economic shifts such as the emergence of China, are generally regarded as the primary source in the wakening pulse of the SSA economy over the last two decades or so. To investigate whether the effects of these reforms altered the broad trends that were reported earlier in any shape of way, we look at the decomposition formula across the sub-periods 1970-1990 and 1990-2010 as laid out by Equation (6).

The results reported in Figure 10 refer to each of the sources underlying labor productivity convergence. The story related to the within-effect remains unaltered in the sense that it contributed to dampening labor productivity convergence but even more so during the 1990-2010 than during the 1970-1990 period (-27 percentage points compared to -10 percentage points). Much of the negative reallocation effect disappeared from 1990 to 2010, a period that has experienced a deployment of labor away from and towards lagging sectors. The between effect has made a consistent positive contribution to the convergence, though larger during the 1990-2010 period compared to the earlier period.

What do these results suggest? They point to large and persistent relative sectoral gaps of the SSA economy resulting primarily from within-effects. This suggests the presence of a combination set of factors: economy-wide distortions that prevent factor input endowments and TFP to lift labor productivity to the U.S. level. The SSA economy offers a striking parallel with the south of the U.S. during the 19th century investigated in the landmark contribution by Caselli and Coleman (2001)—a massive workforce trapped in the agriculture sector leading to low relative productivity performance compared to the north, hypothetically regarded as the frontier. However, there are several differences, one of which is the elimination of any impediment to intersectoral mobility in the U.S. (decline in the cost of education in

rural areas) while they seem to remain important in the SSA. For example, Restuccia et al. (2008) emphasize the presence of distortions that prevent the use of modern technology (e.g., fertilizers and pesticides) and labor mobility from agriculture to non-agriculture (presence of wedges in the payment of labor). Unless these impediments are removed, the SSA will not be in a position to take advantage of a proven source of economic growth that arises from structural transformation.

4 Conclusions

This paper sought to investigate whether the surge in the performance of the SSA economy observed since the early 1990s translated into a reduction in the longstanding, large and widespread economic performance gap with the world frontier. Our paper, thus, shifts the recent debate on SSA away from the question on whether this economy is advancing rapidly towards the quintessential convergence issue along with its underlying economic fundamentals represented by capital deepening and TFP. This question has far-reaching policy implications and yet it remained untapped in the SSA recent economic literature. We tackled this question by combining a top-down approach that performed a nested development accounting exercise with a bottom-up approach the traced the sectoral underpinnings of the aggregate convergence (or the lack of thereof). This framework has been applied to a 11 representative SSA economies over the 1970-2010.

While our results reveal some good news, bad news remain important and suggest that SSA still has a long way to go before changing markedly the trajectory of its development path. In terms of the good news, SSA has partially caught up the level where it were back in the early seventies. For example, the revival of its relative per capita income (labor productivity) at the turn of the new millennium recovered barely one-third (two-fifths) of the gains lost during the 1970-1998 period. Another set of positive news is represented by favorable relative demographic trends and significant advances in the allocative efficiencies

reflected by intersectoral labor productivity gaps that shrunk from 236 in 1970 to 98 in 2010.

These good news are, however, dwarfed by the set of bad news. First, whether expressed in terms of real income per person or labor productivity, SSA economic performance does not show yet any real sign of convergence to the world frontier. Second, at the sectoral level, relative labor productivity gaps are large, broad-based and persistent over time. They primarily result from quantitatively important within-effects which reflect the combination of capital deepening and TFP gaps. Reallocation effects remain insignificant, a reflection of an atypical process of structural transformation—away from and towards sectors with relatively large productivity gaps. All indications point to a combination of favorable shocks behind the SSA wakening pulse rather than a set of economic fundamentals that feature a genuine economic development.

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Appendix A

Table A1: Source data and their corresponding variables

Source data	Variables	Definitions and construction of variables
Penn World Tables 8.0 (PWT8.0), (Accessed on October 16, 2014 from http://www.rug.nl/research/ggdc/data/pwt/)	RGDP^e	Expenditure-side real GDP at chained PPPs (in mil. 2005US$)
	POP	Population (in millions)
	EMP	Number of persons engaged (in millions)
	CK	Capital stock at current PPPs (in mil. 2005US$)
	HK	Index of human capital per person, based on years of schooling (Barro and Lee, 2013) and returns to education (Psacharopoulos, 1994). The data for Ethiopia and Nigeria have been imputed from, respectively, Malawi and Ghana using the similarities of the average (private and social) returns of education available from the Appendix of Psacharopoulos and Patrinos (2004).
	LC	Share of labor compensation in GDP at current national prices. Labor share data were missing for Ethiopia, Ghana, Malawi, Nigeria, and Zambia. Human capital data were missing only for Ethiopia and Nigeria. We imputed the missing data using the closest neighbor technique which is widely used in official statistics. Labor share data are imputed on the basis of similarity in the size of the economy, measured in terms of employment. The following countries have been used to, respectively, impute the labor share data missing for Ethiopia, Ghana, Malawi, Nigeria, and Zambia: South Africa, Kenya, Senegal, South Africa, and Senegal.
Africa Sector Database (ASD), (Based on March 12, 2014 calculations. Raw data were accessed on October 2014 from http://www.rug.nl/research/ggdc/data/africa-sector-database)	VA_Q05	Gross value added at constant 2005 prices (millions)
	EMP	Number of persons engaged (thousands)
	PPPs	Sector-specific PPPs for the 2005 benchmark year
World Development Indicators (WDI), (Accessed on September-November 2014)	SL.EMP.TOTL.SP.ZS	Employment to population ratio, 15+, total (%) (modeled ILO estimate)
	NY.GDP.MKTP.CD	GDP at market prices (current US$)
	NY.GDP.PCAP.KD	GDP per capita (constant 2005 US$)
Bureau of Labor Statistics (Accessed on October 17, 2014)	Employment-population ratio; 16 years and over	
Hanushek and Woessman (2007)	Achievement tests	Performance on international student achievement tests, tracking educational quality over time. The cognitive skills estimates used in this paper were based on the figures reported in Hanushek and Woessman (2007, Figure 3), which were translated into data points after a careful consideration of the scale which was set at 50. We sliced this scale into 10 increments which helped identify the reasonably closest data point. For example, for the U.S. during the 1960s, the closest data point was set at 485. The SSA sample includes Malawi (1960s-70s), Nigeria (1980s), Botswana and Nigeria (1990s), and Botswana (2000s). Achievement tests for SSA were derived from the estimation of the following model: Achievement in period t by country i, $i = a + b * t$. The parameters a and b were estimated using the combination of this sample of countries tracked over time. Based on the panel data of this sample set of the SSA countries, we constructed the fitted values of their achievement tests over the four time periods for which the data are available (1960-1970, 1980s, 1990s and the 2000s) to construct an alternate index of human capital.
GGDC 10-Sector Database (2014 vintage) (Accessed on December 28, 2014 http://www.rug.nl/research/ggdc/data/10-sector-database)	VA_Q05	Gross value added at constant 2005 prices (millions)
	EMP	Number of persons engaged (thousands)

Table A2: Average annual growth rates (%)

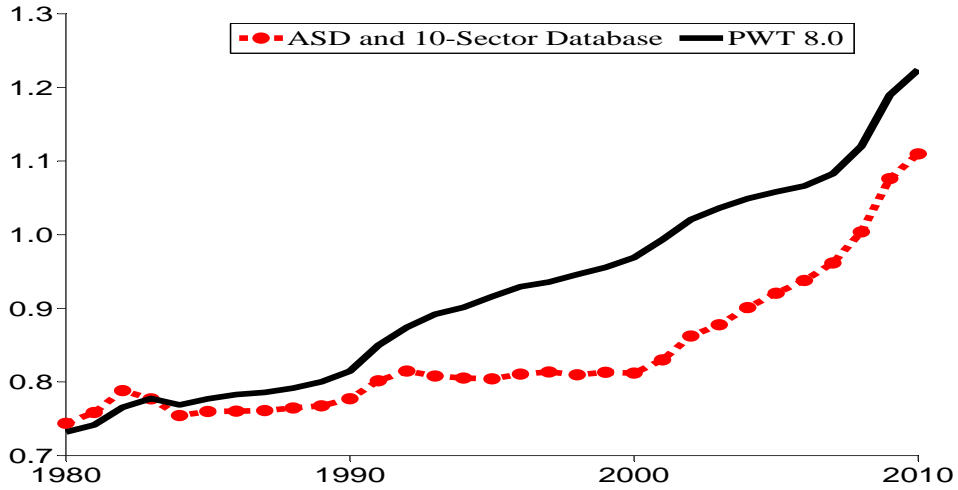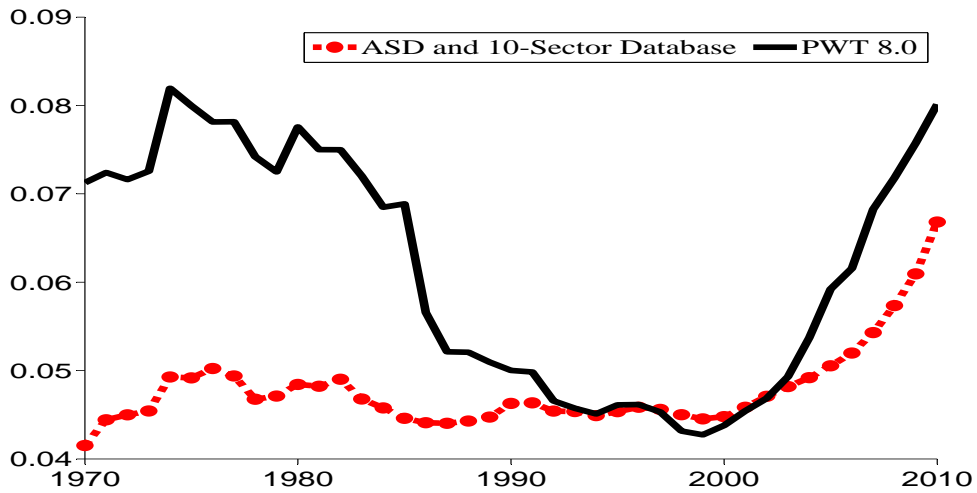| | GDP per capita | | | | |
	1970-2010	1970-1990	1990-2010	1970-1998	1998-2010
SSA	0.47	-1.22	2.19	-1.32	4.78
U.S.	1.83	2.23	1.44	2.18	1.03
SSA-U.S.	-1.36	-3.44	0.75	-3.50	3.75
	Labor productivity				
	1970-2010	1970-1990	1990-2010	1970-1998	1998-2010
SSA	0.60	-1.01	2.24	-0.96	4.34
U.S.	1.51	1.26	1.77	1.47	1.61
SSA-U.S	-0.91	-2.27	0.47	-2.43	2.72

Figure A1: SSA relative gap based on alternate employment series

Figure A2: SSA relative gap using alternate GDP measures