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**Structural transformation, openness, and
productivity growth in sub-Saharan Africa**

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Abstract: This paper examines the connections of structural change and economic openness to labour productivity growth using a panel data set of 41 countries in sub-Saharan Africa for the period 1991–2015. A dynamic panel model of cross-country productivity growth is estimated using the least squares with dummy variables approach. The results suggest that growth of labour productivity is negatively related to initial levels of labour productivity. Labour productivity growth is also positively related to the shares of labour in industry and services. However, the share of labour in agriculture has no statistically significant relationship with labour productivity growth. Economic openness also appears to have a weak relationship with labour productivity growth.

Key words: sub-Saharan Africa, structural transformation, labour productivity growth, economic openness, dynamic panel model, least squares with dummy variables

JEL classification: O11, O47, O55

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1 Introduction

Productivity growth is one of the topical issues and policy priorities in Africa, and will be so over the next foreseeable decades. In recent times, the usual narratives of slow growth in sub-Saharan Africa (SSA) appear to be changing. Some countries in the region have experienced sustained growth over the last two decades.

Growth and structural change are inextricably interconnected. Structural change induces allocative efficiency of resources across sectors, and is thus essential for productivity growth, job creation, and sustainable economic growth. However, there have been some growing concerns about structural change in African economies. The recent growth rates appear devoid of structural change to these economies. Indeed, some empirical studies point to the fact that the recent growth episodes are largely not engineered by changes in the structure of economies but mainly result from commodity booms and favourable external factors (de Vries et al. 2015; Diao and McMillan 2016; Rodrik 2016, 2018).

According to the argument above, the countries in SSA are relatively small opened economies, mainly exporting primary commodities and importing manufactures, and hence benefit greatly from the windfall of booms in commodity prices, stability in the global macroeconomy, and increased aid and capital inflows. In contrast, some recent empirical studies also suggest that growth in the subregion may not be entirely devoid of structural change, especially change in the composition of sectoral labour shares and trade (Diao et al. 2016)

As economies become more globalized, there has been significant interest in the exogenous sources and effects of the structural transformation of countries, especially for developing countries. The argument has been made over time that to properly understand the structural transformation of developing countries and gauge long-term sustainable growth, it is imperative to properly delineate and understand the links among openness, structural change, and productivity growth. For instance, empirical literature on the interconnections of structural transformation, openness, and productivity growth has largely been absent for developing countries.

Traditional trade theories, notably the Ricardian and Heckscher–Ohlin models of trade, point to comparative advantage as one of the significant defining forces of international trade. Trade could evolve over time and influence the structural composition of the aggregate production and sectoral specialization of countries. However, most developing economies such as those in SSA are relatively small, trading mainly in raw materials and primary commodities, and their structural transformation is relatively at the lowest level. Therefore, it is imperative to understand how increasing trade openness can influence the structural transformation trajectories of these countries.

A relatively opened economy could have various implications for labour reallocations. Comparative advantages within domestic sectors could influence the production of sectoral goods and reallocations. Increase in net exports in favour of a particular sector could also influence labour reallocation within and outside of the broad sector, even if structural change in other broad sectors is very slow or at minimum levels.

Also, if the share of expenditure of a sector in aggregate expenditure is falling, then labour reallocation from the sector should naturally follow suit. However, the dynamics of the changing

composition of sectoral labour shares could also be significantly influenced by the sectoral composition of tradable goods. For example, despite the significant fall in the price of manufactures in recent emerging market economies, the manufacturing sectors of these economies still play a significant role in their transformation paths (Świecki 2017; Teignier 2009; Uy et al. 2013). Thus, the key empirical question is: what is the contribution of trade openness to productivity growth, especially if we control for structural change and other possible measures of openness?

The degree of an economy's capital account openness could also influence the inflows of capital and net foreign direct investment (FDI). For example, net inflows of FDI could have mixed effects:

1. Inflow of FDI could come with increased technology and efficiency in large corporations, which may crowd out local and indigenous production in the informal sectors of industry that form the indigenous industrial base in these economies. Indeed, studies have shown that indigenous manufacturing in the SSA subregion has reduced significantly in the last decade owing to competition from large corporations. Meanwhile, most of these corporations employ less local labour (see Backer 2003; Mišun and Tomšk 2002; Twaha et al. 2015).
2. Resources from net inflows of FDI usually go into potentially highly productive areas such as mining and power generation, but these sectors (or subsectors) have limited capacity to employ more labour. Since the SSA countries have no comparative advantage in industry, particularly in manufacturing, lesser shares of actual FDI inflows could go into the subsector of manufacturing, which is usually the significant pivot for robust structural change.

Empirical answers to the issues raised here are imperative for several reasons. For instance, the policies that countries and regional bodies choose in order to stimulate productivity and growth through structural transformation must be grounded in empirical evidence. The question of the policy implications of structural transformation has always been very difficult to answer, given the differential macroeconomic dynamics of countries. Also, the findings of some studies, such as McMillan et al. (2014) and Rodrik (2016), suggest that the effect of factors such as globalization on the structural transformation of countries depends to a great extent on the policy choices and initial conditions of those countries' domestic economies. In this context, as countries in SSA and the African Union (AU) pursue structural transformation as the robust path to sustainable growth, what policy mix should they adopt, especially in the face of increasing vulnerability to openness?

Most empirical studies of structural transformation focus on structural change in an open economy, employing models which remain silent on the contributions of trade and other openness variables to productivity growth. These kinds of analyses are often criticized for not being able to incorporate other possible exogenous variables. Such an omission could confound the actual contribution, and conclusions derived from such specifications about the contribution of structural transformation to growth could be unwarranted. Thus, this study adopts a dynamic panel model (DPM) which can flexibly capture the contributions of structural change and openness to the growth of aggregate labour productivity.

The paper focuses on the growth of labour productivity as the primary measure of aggregate productivity growth. Labour productivity is a sustainable measure of enduring growth because it captures economic dynamics, competitiveness, and structural change (see Freeman 2008). The United Nations Conference on Trade and Development (UNCTAD 2014) argues that economic performance in developing countries depends on the interrelated processes of increasing labour

productivity and productive structural transformation. The growth of labour productivity increases aggregate output and income levels, and stimulates aggregate spending. Thus, an increase in labour productivity is a major determinant of the growth of the real sectors and aggregate economic activities, and can stimulate aggregate demand and economic growth without necessarily causing imbalances in other macroeconomic measures such as inflation (Tenreyro 2018). For instance, GDP growth rates could be influenced by commodity price booms rather than by the changing structure of the composition of sectoral labour shares, tradable goods, and services. In this study, economic openness is defined in terms of trade openness, net inflow of FDI, capital account openness, and globalization.

The rest of the paper is organized as follows. The next section presents some topical issues of productivity growth, openness, and structural transformation in developing countries. Section 3 presents the framework of the DPM and estimation approach, and Section 4 presents some patterns of the key variables of the study. The results are presented in Section 5, and Section 6 presents some robustness tests. Section 7 concludes.

2 Topical issues of structural transformation, openness, and productivity growth in developing countries

The literature on the structural transformation of developing countries has been very mixed and inconclusive, especially regarding the contribution of countries' transformation paths to their growth rates. McMillan et al. (2014) argue that structural transformation has rather been growth-reducing for many African and Latin American countries. The growth-reducing patterns of structural transformation largely result from the early 1990s, when labour reallocated from high-productivity sectors, such as manufacturing, to relatively less productive sectors such as retail and other informal subsectors of services. Rodrik (2016) observes that the recent growth episodes in African countries can largely be traced to the favourable global external environment in the last two decades: booms in primary commodities, low interest rates, and the economic rise of China and other 'Asian tigers' that have increased trade and investment in SSA.

Currently, there are debates in the empirical literature as to whether productivity growth triggers structural transformation or vice versa (see Echevarria 2000; McMillan et al. 2014; Timmer et al. 2012). For instance, in the advanced economies (AEs) with a higher level of transformation, there were significant increases in real GDP and labour productivity during the period of their structural transformation. This in turn led to the reallocation of resources to high-productivity sectors. In a comparative study of the structural transformation of India and China, Rada and von Arnim (2012) show that the growth of labour productivity was significant for the reallocation of labour to other sectors and job creation in China.

Another paradigm of the structural transformation paths of all countries is the direct and/or indirect contribution of trade. Earlier literature points to trade as one of the sources of the structural transformation of countries (e.g. Kuznets 1973; Syrquin 1988). Also, the past two decades have witnessed a wave of both empirical literature and policy identifying trade liberalization as an efficient path to the growth of developing countries, through a deepening of the competitiveness of domestic firms and technology transfers. With a relatively small share of global trade, African economies have become more integrated into the global economy. Over the past three decades, consistent and conscious macroeconomic policy drives aimed at stability and growth have led to the liberalization of domestic markets, the modernization and liberalization of

agricultural production, opening up to international trade, and flexible monetary controls in most African countries (McMillan et al. 2014; Rodrik 2018).

Evolutions in trade in both size and composition could trigger resource reallocations in the economy. In recent years, for example, increased trade in manufactures and technology-intensive services has induced rapid structural transformation in the trade size and composition of China and Korea, contributing significantly to their aggregate productivity growth rates. Teignier (2009) notes that trade has contributed to the structural transformation of the UK; and for Korea, the contributions would have been greater if there were no agricultural import restrictions.

Syrquin (1988) observes that the early stages of the structural transformation of countries are usually characterized by the export of commodities from light industries. Exports then shift towards the outputs of heavy or capital-intensive industries as income increases. Świącki (2017) and Uy et al. (2013) show that international trade could be a significant source of structural transformation, but with differing effects depending on the country's degree of openness. McMillan et al. (2014) identify three factors which could determine the extent to which structural change can contribute to the growth of a country: (1) the country's revealed comparative advantage, (2) flexibility in the labour market, and (3) the competitiveness of the domestic currency. All of these factors are influenced by the degree of a country's openness.

The effect of globalization has become very pervasive. All countries have become relatively globalized, so it is natural to think that globalization will have made some contribution to the process of structural transformation of developing countries—although the contribution is largely indirect and is heavily dependent on the country's local circumstances and domestic policy choices. For instance, unlike in Asian emerging economies such as China, Korea, and India, where globalization appears to have contributed to productivity growth, in SSA, globalization appears rather to have driven labour from higher- to lower-productivity sectors. Large shares of labour have moved to the informal subsectors of the economy (McMillan et al. 2014).

In the view of Rodrik, a possible contribution to the patterns of premature de-industrialization in Africa is that 'Africa finds itself in an environment where it is facing much stronger head winds' (2018: 15). Globalization has resulted in a widening of the effects of global trade competitiveness, from impacting only on the world markets to affecting even domestic markets. And this has an effect on the structural transformation trajectories of SSA countries, especially as they continue to pursue increasing openness through the liberalization of key sectors. Multinational corporations and global production chains have become dominant players in both the global and the domestic markets. Hence, developing countries are left with narrow options: either compete with or join the dominant players through value added chains. However, low levels of comparative advantage in both capital intensity and technological innovation make both options very difficult for developing countries. This leaves most of them with narrow pathways towards robust structural transformation.

On the positive side, globalization has immense benefits also for developing economies. For instance, the capital account openness of countries has the potential to make capital available to developing countries at a cheaper cost as they seek to build their infrastructure. Easy and relatively cheap access to capital gives them a little more fiscal space than the usually accumulated sovereign debts. They also now have access to large markets. Matsuyama (2019) shows that globalization could change the terms of trade in favour of small countries, because it could reduce the disadvantage of trade cost associated with being a small country in global trade.

Capital account liberalization and innovations in global financial systems have deepened the flow of capital between economies. Most developing countries, recognizing the possible positive effects of such free movement of large amounts of capital across nations, continue to position themselves as the preferred investment destinations. Theoretically, increased access to capital should enhance the efficiency, competitiveness and diversification, wealth and job creation, income gains, and overall aggregate growth of countries. Capital account openness could also impact on the structural transformation of developing countries through changes in factor income shares.

There is, however, an empirical argument that capital account openness could also negatively affect the labour share of income. Lee and Jayadev (2005) review the findings of several empirical studies, which mostly show some systematic negative relationship between capital account openness and the labour share of income, suggesting that capital account openness may be unfavourable to the improvement of domestic labour conditions. They also observe that the effects of financial openness on growth could be somewhat dependent on the initial conditions and the period of consideration. Other empirical studies, such as Rodrik (1997), suggest that capital account openness could worsen labour conditions in developing countries because the availability of capital at cheaper cost could result in labour losing the bargaining power required to command increases in income levels. This could mean that the contributions of labour to aggregate production could be reduced. On a sectoral basis, a sector with low marginal productivity of labour and high capital shares could witness a reallocation of labour away from the sector.

3 Dynamic panel model

The DPM can efficiently handle the endogeneity issues associated with cross-country growth analysis. The model can capture heterogeneities in aggregate production across economies and endogenous regressors, and can allow for broader exploitation of the causal direction of the growth process, especially in cross-country analysis. The DPM can capture feedback effects from the current values of the dependent variables to the future value of the regressors, and is thus able to capture reverse causality when the regressors are predetermined (see Arellano 2003; Nickell 1981; Wooldridge 2002). Given these features, the DPM can accommodate some of the key challenges of modelling cross-country growth analysis: unobserved confounders, lagged dependent variables, and endogenous regressors (Barro and Lee 1994; Barro and Sala-i-Martin 1997; Bond et al. 2001; Caselli et al. 1996; Islam 1995; Levine et al. 2000; Moral-Benito et al. 2019).

Islam (1995) demonstrates that dynamic panel analysis can account for cross-country growth dynamics and correct the omitted variable bias usually associated with single cross-sectional growth analysis, as it allows for the control of country-specific effects such as differences in technical deepening. This cannot be done effectively with other traditional panel models, such as the pure fixed effects, random effects, and cross-sectional models (Wooldridge 2002). Random effects models are difficult to estimate for dynamic panels, partly because of the lagged dependent variable (Bhargava and Sargan 1983). Direct fixed effects application in dynamic models could also be problematic due to the presence of the lagged dependant variable as a regressor (see Nickell 1981).

On the growth paths of countries, there could be reverse causality in the growth of labour productivity and other structural variables such as sectoral shares of labour. Changes in aggregate labour productivity depend primarily on changes in sectoral productivity, employment share, and other inputs such as capital stock. Thus, on the structural transformation processes of countries, the lagged values of aggregate productivity and shifts in sectoral composition of labour could simultaneously affect growth. Therefore, the growth of aggregate labour productivity can be

expressed as a function of its lagged values, the level of labour productivity at the start of a period, the sectoral shares of labour, and other structural variables that could influence aggregate production.

Consider the growth of labour productivity (PG_{it}) in country i at time t defined as:

$$PG_{it} = \ln\left(\frac{P_{it}}{P_{it-1}}\right) = \ln(P_{it}) - \ln(P_{it-1}) \quad (1)$$

The dynamic relationship of labour productivity growth and structural change in the country can be expressed as:

$$PG_{it} = \beta_1(PG_{it-1}) + \beta_2 \ln(P_{it-1}) + \beta_3 \ln(S_{ijt}) + \beta_4 \ln(K_{it}) + \eta_i + \xi_t + \mu_{it} \quad (2)$$

where PG_{it} is the growth of aggregate labour productivity in country i at time t and defined as $\ln(P_{it}) - \ln(P_{it-1})$; P_{it} is the level of labour productivity at the end of the period; P_{it-1} is the level of labour productivity at the start of the period; PG_{it-1} is the lagged aggregate productivity growth; S_{ijt} is the share of labour in sector j of country i at time t ; K_{it} is the total capital stock; η_i and ξ_t are country and period effects respectively; and μ_{it} is the error term.

Equation 2 does not capture openness variables. However, changes in productivity may also be influenced by the exogenous forces of openness which are not explicitly or may not be implicitly captured in sectoral production composition. Thus, Equation 2 is augmented with the key measures of openness variables to capture the effects of economic openness on aggregate productivity growth, as shown in Equation 3:

$$PG_{it} = \beta_1(PG_{it-1}) + \beta_2 \ln(P_{it-1}) + \beta_3 \ln(S_{ijt}) + \beta_4 \ln(K_{it}) + \beta_5 \ln(IM_{it}) + \beta_6 \ln(EX_{it}) + \beta_7(FDI_{it}) + \beta_8(CAO_{it}) + \eta_i + \xi_t + \nu_{it} \quad (3)$$

where IM_{it} and EX_{it} are total imports and total exports respectively. FDI is the net inflow of FDI. CAO is the index of capital account openness. These three variables are the key measures of economic openness in this study. ν_{it} is the error term. Since the sectoral shares of labour sum up to 1, they are captured in the regression in logarithm form to avoid incidence of collinearity. Hence the coefficients of the sectoral shares of labour are interpreted as the response of the growth of labour productivity to proportionate change in the shares of sectoral labour. The other controlled variables, which are measured in percentages and indices are not captured in log form, to avoid the difficulties of logarithmic transformation of indices or negative values.

Neoclassical growth models underscore the importance of the initial level of income in cross-country growth analysis. The growth convergence hypothesis argues that countries with initially low levels of labour productivity will tend to grow faster. This implies that the growth of labour productivity will be inversely related to the initial level of productivity. Therefore, a negative coefficient of the initial level of productivity means that countries with initially low levels of productivity grow faster than those with initially high levels of productivity, while a positive coefficient means that countries with initially high levels of productivity experience higher growth than those with initially low levels of productivity. The model for this study controls for other variables that could influence heterogeneities in production across countries. Hence, the coefficient of the initial level of labour productivity will capture the possible conditional convergence of productivity growth (see Barro 2003; Solow 1956).

The sectoral labour share variable is the basic measure of structural change in this study. It captures the effects on the growth of aggregate labour productivity of changes in the share of sectoral labour, and, by implication, reallocation of labour over time.

Net inflows of FDI can be considered a structural variable, and also a measure of some degree of openness. Trade (imports and exports) and capital account openness capture the effects of economic openness on the growth of labour productivity. The globalization variable is excluded from the regression because it is highly collinear with the trade and capital account openness variables.

Note that there is also a subtle difference between the lagged dependent variable and the initial level of productivity variable, especially as labour productivity is measured in growth terms. The lagged dependent variable captures the effect of previous growth of labour productivity on current growth. While there may be endogeneity issues in capturing these two variables at the right-hand side of the regression, such endogeneity will be addressed by the dynamic structure of the model.

An annual time period appears too short an interval over which to study the structural transformation of countries. It takes time for countries to experience significant reallocations of labour and a consequential effect on productivity growth. Shorter time periods could also be influenced by short-term shocks which may be difficult to control for in a cross-country growth model. For example, Barro and Lee (1994) use the overlapping ten-year sub-periods 1965–75 and 1975–85 for a sample of 97 countries. Levine et al. (2000) use non-overlapping five-year sub-periods for 74 countries over 1961–95 to study financial intermediation and economic growth across countries. Islam (1995) uses the 25-year period 1960–85 for various categories of countries.

Following these studies, this study uses non-overlapping five-year sub-periods for a panel of 41 countries over the period 1991–2015, which translates to $T=5$, $N=41$, and 205 observations. This specification is particularly important for the study of the productivity growth path of SSA countries given the usual debate regarding the effect of business cycles. The argument has been advanced that the growth in most SSA countries over the last few decades has largely been influenced by commodity booms (see McMillan et al. 2014).

3.1 Model estimations

Following the seminal works of Bond et al. (2001) and Caselli et al. (1996), generalized method of moments (GMM) estimators have been the most popular econometric estimation approach for DPM. The generalized least square (GLS) estimator has also been used by Barro and Lee (1994) and Barro and Sala-i-Martin (1997) to deal with the endogeneity problems associated with DPM. However, Caselli et al. (1996) argue that the GLS estimator only partially corrects the endogeneity problem.

Caselli et al. (1996) demonstrate some difficulties with the estimation of empirical cross-country growth models: (1) the specification and treatment of country-specific effects and omitted variable bias, and (2) endogeneity and measurement errors in relation to the right-hand-side variables. They propose the difference GMM estimator to help solve the individual effect and endogeneity problems through differencing and instrumenting the right-hand-side variables with their lagged values.

In a systematic approach, Roodman (2009) demonstrates the superiority of the GMM over other estimators for DPM. The most popular of the GMM estimators are the difference GMM and system GMM estimators. Generally, however, the efficiency of the GMM estimators depends

crucially on the use of the lagged dependent variable and other explanatory variables as valid instruments. The GMM estimates can be seriously impaired by finite sample bias when instruments are weak. Kraay (2015) argues that in most cases, the instruments are weak, invalid, or both. The estimates of the GMM can also be seriously impaired by contemporaneous correlations.

Bond et al. (2001) show that the difference GMM estimation could be flawed. Weak instruments may lead to finite sample bias and influence the efficiency of the GMM estimates. The difference GMM may also be poorly behaved for models with persistent time series and a small number of time series observations (small T). Also, due to differencing of the regressors, the fixed effects ultimately drop off in the difference GMM estimations.

However, fixed effects are important in a cross-country growth analysis, to help capture the unobserved heterogeneities which could influence the growth dynamics of countries (Islam 1995). Thus, Bond et al. (2001) propose the system GMM estimator and show that it offers a better estimation of DPM than the difference GMM estimator, with superior finite sample properties, and is better suited to models with persistent panel data. Roodman (2006) also demonstrates that the system GMM estimation is more efficient and less biased for dynamic panels under several conditions than the difference GMM estimator of Arellano and Bond (1991).

On the other hand, the system GMM estimator is also based on assumptions which may be difficult to satisfy in most empirical analysis. For instance, it is based on the assumption that the fixed effects are uncorrelated with the first differences of the regressors, which allows for the introduction of more instruments to improve efficiency. The system estimator also relies on the assumption of mean stationarity, which has been difficult to satisfy in most empirical analyses. For example, mean stationarity requires long time series data, which may be difficult to satisfy in dynamic panel analysis (Moral-Benito et al. 2018). Although the system GMM estimator attempts to correct the defects of the difference GMM through the inclusion of fixed effects, Roodman (2006) argues that the system estimator could also be poorly behaved when N is small.

To address the efficiency difficulties associated with the GMM estimator, especially in small N samples, maximum likelihood estimation has been proposed, notably by Allison et al. (2017), Hsiao et al. (2002), Moral-Benito et al. (2018), and Williams et al. (2018). Maximum likelihood estimation, which is based on structural equation modelling (ML-SEM), can offer superior estimates for dynamic panels with small N, and can effectively address the finite sample problem of the GMM estimator. Moral-Benito (2013) demonstrates that ML-SEM can produce consistent estimates even when the normality assumption is not fully met. Williams et al. (2018) show also that ML-SEM can relax many of the assumptions of the GMM estimator and allow for unrestricted effects of time on the regression.

The ML-SEM estimator relaxes the assumption of strict exogeneity of the regressors and allows for feedback effects from the dependent variables to the current values of the regressors. It can also allow for the inclusion of fixed effects and latent variables to control for individual effects. The estimator is also able to handle the autoregressive effect of the lagged dependent variable. Missing data can also be handled by full-information maximum likelihood. However, despite the attractive features of the ML-SEM estimation approach, it is sometimes saddled with convergence problems and the estimates can be extremely sensitive to estimation specifications (Williams et al. 2018).

Closely related to the ML-SEM estimator is the quasi maximum likelihood (QML) estimation approach based on the theoretical works of Bhargava and Sargan (1983) and Hsiao et al. (2002). QML is a limited-information maximum likelihood estimator which is a special case of ML-SEM

with cross-equation restrictions (Kripfganz 2016). However, Williams et al. (2018) argue that the QLM estimator is effective for strictly exogenous variables but has difficulties with predetermined and time-invariant variables in a fixed effects model. The assumptions of Hsiao et al. (2002) about initial conditions are questionable.

Therefore, the traditional GMM, ML-SEM, and QML estimators of dynamic panels may not be suitable for this study. The study instead employs the least squares with dummy variables (LSDV) estimator. Islam (1995) argues that the LSDV estimator will still be valid for dynamic panels when asymptotic properties of panel data are considered in the direction of T; LSDV can be consistent with maximum likelihood estimates (see Amemiya 1967); and Islam (1995) finds that the LSDV estimator performs well in dynamic panels.

The data include 41 SSA countries over the period 1991–2015. The choice of countries is based on the availability of data for the key variables. The period is split into five non-overlapping five-year sub-periods: 1991–95, 1996–2000, 2001–05, 2006–10, and 2011–15. The initial value of labour productivity (P_{t-1}) is the level of labour productivity at the beginning of the period, and the current value is the level of labour productivity (P_t) at the end of the period. For example, for the first sub-period P_{t-1} is the level of labour productivity in 1991 and P_t is the level in 1995. Similar measures apply for other sub-periods. Thus, the growth of labour productivity is measured as the difference in the log of labour productivity for the beginning and ending years of the sub-periods. The other regressors—sectoral share of labour, capital stock, net inflow of FDI, capital account openness index, and total exports and total imports—are measured as the averages of the variables over the five-year sub-periods (see Barro and Lee 1994; Islam 1995).

A test of multicollinearity of the variables with the variance inflation factor suggests collinearity among the following openness variables: trade, net inflow of FDI, capital account openness index, and globalization index. Thus, the globalization variable is excluded from the regression, which effectively solves the problem. The measures of economic openness are then restricted to net trade, net inflow of FDI, and capital account openness.

3.2 Data

The data are drawn mainly from four sources: the databases of UN Main Economic Aggregates (UN Statistics Division 2019), World Bank economic indicators (World Bank 2019), International Labour Organization (ILO) labour statistics (ILO 2019), and the International Monetary Fund (IMF 2019). Aggregate labour productivity is the total value of output per worker in the economy. This captures the contribution of each worker to the growth of output and to the overall economy. The ILO database maintains data on aggregate labour productivity measured at constant 2005 USD prices. Sectoral labour share is measured as the percentage of the aggregate labour employed in the sector. The data for the sectoral share of labour are also available from the ILO database. Labour shares are for the broad sectors of agriculture, industry, and services.

The data for GDP and exports and imports are obtained from the UN database of Main Economic Aggregates. They are all measured at constant 2010 USD prices. Net trade is calculated as the difference between total exports and imports.

The data for the capital stock are from the IMF database, and based on the work of Gupta et al. (2014). Capital stock is measured in billions of constant 2011 international dollars. The total economy's capital stock is calculated as the sum of private capital stock, public capital stock, and public-private capital stock.

Data for net inflow of FDI is from the World Bank database of economic indicators. Net inflow of FDI is measured as a percentage of GDP. The indices for capital account openness are based on the work of Chinn and Ito (2008). The indices are normalized between 0 and 1, where 1 indicates high capital account openness. The indices of globalization are from the KOF 2018 updated version of globalization indices, which is based on the work of Dreher (2007). Since we are interested in the effects of overall openness, we use the overall indices of globalization, which capture the political, social, and economic globalization of countries. The indices are between 1 and 100, where 100 indicates high globalization.

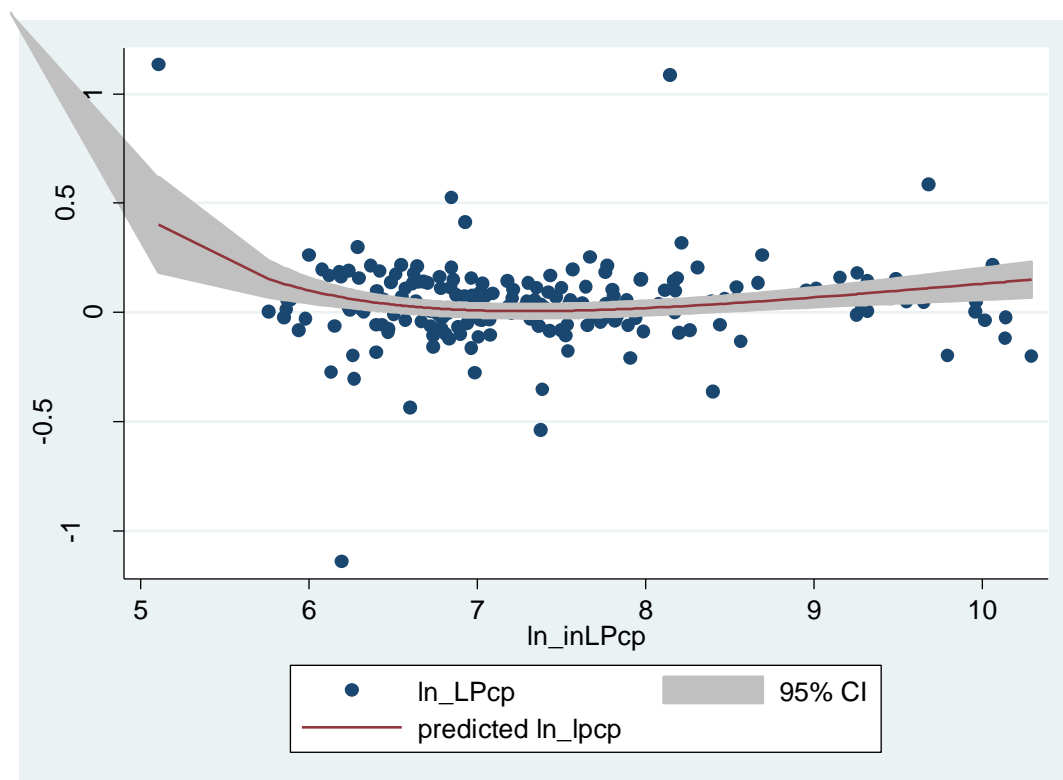
4 Summary statistics for the key variables

This section presents descriptive patterns of the key variables of the study. These patterns offer some basic insights into the key issues of growth across the countries.

One of the key issues in cross-country growth analysis is growth convergence. The convergence hypothesis posits that countries with initially low levels of productivity will tend to have high growth in productivity in order to catch up with the countries with initially high levels of productivity. For instance, if the countries in SSA are structurally similar, in terms of savings, population growth, capital accumulation, and exogenously given level of technology, then they will have the same steady level of productivity and capital per person, which grow at a constant rate with the given rate of exogenous technical progress. Thus, if the only difference across the countries is their initial levels of productivity and capital per person, the absolute convergence hypothesis posits that the countries with initially low productivity levels will typically grow faster to catch up with the countries with high productivity levels (Barro and Sala-i-Martin 1992, 1997, 2004).

Figure 1 presents the growth of labour productivity for the five-year sub-periods on the vertical axis, and the labour productivity levels at the start of the sub-periods on the horizontal axis, for the SSA countries over the period 1991–2015. The graph shows neither a strong positive nor a strong negative relationship between the growth of labour productivity over the sub-periods and the levels of labour productivity at the start of the sub-periods. Indeed, the fitted curve is fairly flat, suggesting that the basic underlining pattern of the data does not appear to support the hypothesis of absolute convergence. SSA countries with initially low levels of productivity may not be growing faster than those with initially high levels of labour productivity.

Figure 1: Growth of labour productivity and initial levels of labour productivity in SSA, 1991–2015



Note: Ln_inLPcp is the log of initial labour productivity at the start of the sub-periods.

Source: Author's construction based on ILO (2019).

The graph also indicates very low dispersions in the relationship between the growth of labour productivity and the starting levels of labour productivity for the sub-periods. However, such low dispersion in the growth rate across countries need not be confused with the convergence hypothesis of cross-country growth analysis. The convergence hypothesis simply suggests that, relative to initial levels of productivity, countries with low levels of labour productivity will grow faster. This does not necessarily mean that the growth rate across countries will converge to a similar path over time. Barro and Sala-i-Martin (2004) show that even in the presence of absolute convergence, growth rates across countries need not converge over time.

However, Figure 1 does not necessarily rule out the convergence hypothesis. There may be *conditional* rather than *absolute* growth convergence. The conditional convergence hypothesis suggests that countries with initially low levels of labour productivity will tend to have high growth in labour productivity, dependent on other control variables of the steady state of the economy. For instance, factors such as domestic labour market conditions, polity, and institutional infrastructure could influence supply-side conditions and cause a difference in the aggregate production functions and steady states of labour productivity, consumption, and capital per person. Thus, these factors should be held constant in analysing the inverse relationship between the growth of labour productivity and the initial levels of labour productivity of countries (Barro 2003).

Table 1 presents summary statistics for the key variables of the study. There have been some gains in the levels of labour productivity from 1991–95 through to 2010–15. For instance, over the period, the difference between the average values of labour productivity of the latest (2010–15) and earliest (1991–96) sub-periods is 1,544.64, which is a significant gain. The standard deviation

of labour productivity has also increased over the period, indicating that there may have been significant variation in the levels of productivity across the countries.

In Table 1, the average share of labour in agriculture has declined steadily over the years, although, agriculture still has the largest average share of labour. This is consistent with the findings of other studies, such as Davis et al. (2017), that rural households in SSA are still greatly concentrated on and specialized in farm activities. Indeed, rural households will prefer farm to non-farm activities when the climatic conditions are favourable. Non-farm economic activities are also closely related to agricultural production. Thus, agriculture continues to dominate, with the highest share of labour in most countries in SSA.

The average share of labour in industry has also declined marginally, with decreasing standard deviations as well, suggesting that the gaps in industrial share of labour across the countries may be reducing too, albeit marginally. However, services have experienced an increase in their average share of labour. This shows that, on average, high labour shares may be moving towards industry and services. These patterns of labour reallocation in Africa appear remarkably different from the stylized facts of structural transformation of the current AEs, where industrial development, the share of labour in industry, and productivity increased extensively before services gained their current higher share of labour.

While these brief descriptive patterns offer some useful information about the structural transformation paths of the countries, cross-country growth analysis based on descriptive patterns usually offers limited information. We need to control for both observed and unobserved factors such as country-specific effects to gain deeper insight into the contributions of structural change to the growth of income. Thus, the next section presents the results of the dynamic panel regressions which control for some of the observed and unobserved factors.

Table 1: Summary statistics for the key variables, 1991–2015

Periods	Number of observations	Labour productivity		Capital stock		Share of labour in agriculture		Share of labour in industry		Share of labour in services	
		Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
1991–95	205	3,035.87	4,716.35	72.25	166.52	62.07	18.72	10.15	7.44	27.79	12.45
1996–2000	205	3,235.13	4,918.22	75.29	167.96	61.19	19.06	9.64	6.94	29.16	13.36
2001–05	205	3,724.50	5,704.31	79.47	169.96	59.73	19.99	9.55	6.81	30.72	14.42
2006–10	205	4,220.85	6,495.35	94.19	199.26	57.91	20.47	9.52	6.36	32.56	15.30
2011–15	205	4,580.51	6,870.21	122.55	247.80	56.65	20.42	9.53	5.91	33.82	15.79

Note: The data are for 41 sub-Saharan African countries.

Source: Author's construction based on ILO (2019), IMF (2019), UN Statistics Division (2019), and World Bank (2019).

5 Results

Table 2 presents the LSDV estimation results. Column 1 is parsimonious, with just the lagged dependent variable, levels of labour productivity at the start of the sub-periods, and sectoral share of labour variables. The subsequent columns sequentially include capital stock, imports, exports, net inflow of FDI, and capital account openness.

Generally, there are four main findings: (1) structural change in industry and services is statistically significant, and positively associated with labour productivity growth; (2) structural change in agriculture is statistically insignificant for the growth of labour productivity; (3) openness appears to have a weak statistically significant relationship with the growth of labour productivity; (4) country-level fixed effects are significant in the labour productivity growth paths of SSA countries.

The results indicate that, on average, initial levels of labour productivity are negatively and significantly linked to the growth of labour productivity. The coefficients of the initial levels of labour productivity are relatively stable with regard to the sensitivity of including other right-hand-side variables. These findings suggest some conditional convergence of the growth of labour productivity across the countries given the initial productivity levels. While the results do not include all parameters or offer sufficient grounds for further analysis of the hypothesis of growth convergence, the key point is that heterogeneities exist in the labour productivity growth paths of the countries. This is further shown when the results in Table 1 are compared with the results of the second robustness test in Table A2 in the Appendix.

The results also suggest that changes in the share of labour in agriculture do not have any statistically significant effect on the growth of labour productivity over the period. This appears counterintuitive, because the average share of labour in agriculture has been declining over the years (as shown in Table 1). This should ideally translate to some rise in productivity of the sector and contribute positively to the growth of aggregate labour productivity. However, these results are not surprising when compared with the findings of similar studies. For example, UNCTAD (2014) shows that agriculture productivity growth was largely stagnant in African Least Developed Countries (LDCs) for the period 1991–2012.

Changes in the share of labour in industry and services appear to contribute significantly to aggregate labour productivity growth, with services having higher coefficients. Although this effect is not very emphatic, it appears to support the narrative that the services sector is becoming the lead contributor to productivity growth in developing countries (e.g. UNCTAD 2017). For example, Haile (2018) also finds that most of the jobs created in Benin, Burkina Faso, and Côte d'Ivoire were in informal services, the manufacturing share of valued added has dropped, and the services sector has picked up as the largest contributor (of about 50 per cent) to the domestic economies of these countries.

Perhaps, a surprising observation from the results is the negative coefficients of total capital stock, although the coefficients are not statistically different from zero. There are several issues arising out of the measurement and usage of capital in developing countries. Thus, we are cautious about making further analysis of the effects of capital stock. However, this does not challenge the familiar arguments that continuous capital-deepening could be one of the ways to raise productivity levels in SSA.

Table 2: Labour productivity growth, structural transformation, and economic openness in SSA, 1991–2015: LSDV estimation

	(1)	(2)	(3)	(4)	(5)
	Growth of labour productivity	Growth of labour productivity	Growth of labour productivity	Growth of labour productivity	Growth of labour productivity
Lagged growth of labour productivity	-0.056 (0.148)	-0.076 (0.150)	-0.138 (0.144)	-0.142 (0.138)	-0.140 (0.137)
Log of initial level of labour productivity	-0.604*** (0.089)	-0.570*** (0.130)	-0.569*** (0.126)	-0.564*** (0.133)	-0.549*** (0.131)
Log of share of total employment in agriculture	0.060 (0.051)	0.068 (0.056)	0.001 (0.057)	-0.013 (0.051)	-0.002 (0.053)
Log of share of total employment in industry	0.216*** (0.052)	0.216*** (0.052)	0.150*** (0.052)	0.149*** (0.050)	0.140*** (0.052)
Log of share of total employment in services	0.376** (0.188)	0.374** (0.185)	0.339** (0.156)	0.294* (0.153)	0.288* (0.151)
Log of total capital stock		-0.035 (0.092)	-0.071 (0.086)	-0.050 (0.075)	-0.058 (0.077)
Log of total exports			0.076* (0.042)	0.090** (0.040)	0.089** (0.039)
Log of total imports			0.059 (0.048)	0.039 (0.046)	0.044 (0.046)
Net inflow of FDI				0.002 (0.003)	0.002 (0.002)
Capital account openness					-0.090 (0.109)
Observations	164	164	164	164	164
R-squared	0.757	0.757	0.786	0.789	0.791
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Period fixed effects	Yes	Yes	Yes	Yes	Yes

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Growth of labour productivity is measured at five-year sub-periods: 1991–95, 1996–2000, 2001–05, 2006–10, and 2011–15.

Source: Author's construction based on ILO (2019), IMF (2019), UN Statistics Division (2019), and World Bank (2019).

Trade has often been cited as the next frontier of growth for developing economies (see UNCTAD 2017). However, the effect of trade on productivity growth depends on countries' terms of trade with the rest of the world. Terms of trade determine the composition and growth of both exports and imports. Thus, trade is usually viewed as one of the ways to transform production technologies and enhance technological spillover. For most developed economies, trade openness has been linked to economic transformation through changes in the composition of output, consumption structure, and labour-serving technologies. However, as observed from the results, although the coefficient of exports is positive and statistically significant, generally the effect of trade on aggregate labour productivity growth appears rather weak.

Overall, the results provide no strong case for the contribution of economic openness to the growth of aggregate labour productivity. Barro (1996) argues that changes in income occur only if trade openness can stimulate changes in sectoral employment shares and the composition of output. Indeed, regardless of the scale of economic openness, if the composition of the aggregate output and trade of an economy remain the same, the effect on productivity growth will remain weak. Traditionally, African countries have depended to a large extent on the export of primary commodities and the import of manufacturers. This traditional trade composition may need to be substantially transformed to achieve significant contributions of trade to productivity growth.

6 Robustness test

For the first sensitivity test of the results, the growth of labour productivity and the averages of the explanatory variables are measured at three-year sub-periods. The model specification and estimation technique remain the same. The estimates are presented in Table A1 in the Appendix.

The results are consistent in terms of the direction of the coefficients. There are, however, some notable differences:

1. The size of the coefficients, especially for the initial levels of labour productivity, has reduced substantially. This suggests that the effect of the conditional convergence of productivity growth may be low when productivity is measured at shorter interval periods.
2. The coefficients of the share of labour in industry are only statistically significant in the first two columns (without the openness variables), while the coefficients of the share of labour in services are no more statistically significant.
3. The coefficients of the lagged dependant variable are statistically significant in only the first two columns.
4. The R-squared values are lower compared with the baseline results in Table 2.

These results suggest that analysing the growth of labour productivity over shorter spans of time may have some effect on the results.

Given these results, it would have been ideal to also test for the sensitiveness of the results for longer sub-periods, e.g. eight-year sub-periods. However, this cannot be done due to the small sample size and data limitations.

The second robustness test omits the country fixed effects and maintains only the period fixed effects, a pooled estimation across the countries. This dramatically changes the results. The coefficients of the initial level of labour productivity are no longer statistically significant. The coefficients of the shares of labour in industry and services are also no longer statistically significant. The coefficients of FDI and capital stock are now statistically significant. Compared with the fixed effects model, the explanatory power of the pooled model is very low, as shown by the low values of R-squared. Also, the coefficients of the period effects are not statistically different from zero. Generally, the results suggest that heterogeneities exist across the countries.

7 Conclusions

This paper has employed a dynamic panel data analysis to study the casual link of structural transformation and economic openness to economic growth in SSA. The results suggest the

conditional convergence of the growth of labour productivity across the countries. Also, labour productivity growth is influenced to a larger extent by changes in the shares of labour in industry and services than by the share of labour in agriculture.

The results offer some useful information about the challenges of structural change in the agriculture sectors of SSA economies. For instance, the reallocation of labour out of the sector (as shown by declining average shares of labour in agriculture) should positively affect the growth of aggregate productivity even if sectoral productivity levels remain constant. Also, if sectoral value added remains constant or increases with increasing capital stock, then labour productivity in the agriculture sector should naturally increase. However, neither of these things seem to have happened.

For strong growth and economic transformation, the countries may need to look at increasing labour productivity growth beyond the current levels. As shown, the current growth levels and contribution of the labour share of agriculture (the sector with the highest labour share) do not offer the prospect of substantial economic transformation and productivity growth. However, this does not suggest that the countries cannot substantially increase productivity levels.

While the agriculture sector still has the average highest labour share, the challenge for the countries now is to increase sectoral and aggregate productivity levels by adopting efficient production technologies and intra-sector transformation. The countries need to scale up the efficient integration of labour-serving technologies in agriculture production.

Continuous sectoral capital-deepening (not just aggregate capital accumulation) is essential to raising productivity levels. While doing this, the most important lesson to also note is that productivity growth only occurs to the extent of efficiency and flexibility in the labour markets, and the substitutability of factors on the growth path. These are what push the reallocation of resources to productive sectors.

Services are emerging as the biggest sector in developing economies, including most SSA countries. This could present both opportunities and challenges for growth and structural transformation. UNCTAD (2017) argues that the services economy has the potential to enhance the structural transformation and growth processes of developing countries and integrate them into the global economy. There are opportunities in the digital economy, telecommunications, finance, energy, and other sub-sectors of services in many developing economies. The results of the study appear to support this argument.

However, there are also inherent potential challenges to the structural transformation of these economies even with the growth of services. Employment in services will be limited if other sectors remain stagnant. If the growth of services productivity is not accompanied by a substantial growth in aggregate demand, employment growth could even decline in the short to medium term and further worsen the sectoral productivity gaps (UNCTAD 2014).

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Appendix

Table A1: Labour productivity growth, structural transformation, and economic openness in SSA, 1991–2015: LSDV estimation (robustness test with exports and imports)

	(1)	(2)	(3)	(4)
	Growth of labour productivity	Growth of labour productivity	Growth of labour productivity	Growth of labour productivity
Lagged growth of labour productivity	0.166* (0.091)	0.173* (0.099)	0.141 (0.098)	0.094 (0.097)
Log of initial level of labour productivity	-0.199*** (0.061)	-0.210*** (0.067)	-0.246*** (0.069)	-0.256*** (0.076)
Log of share of total employment in agriculture	0.006 (0.037)	0.004 (0.039)	-0.025 (0.042)	-0.023 (0.043)
Log of share of total employment in industry	0.066** (0.032)	0.067** (0.032)	0.045 (0.032)	0.043 (0.032)
Log of share of total employment in services	0.126 (0.099)	0.130 (0.092)	0.132 (0.081)	0.128 (0.080)
Log of total capital Stock		0.010 (0.047)	-0.001 (0.042)	-0.008 (0.041)
Log of total exports			0.045* (0.025)	0.044* (0.025)
Log of total imports			0.017 (0.027)	0.015 (0.026)
Net inflow of FDI				-0.001 (0.001)
Observations	287	287	287	285
R-squared	0.482	0.482	0.514	0.520
Country fixed effects	Yes	Yes	Yes	Yes
Period fixed effects	Yes	Yes	Yes	Yes

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Growth of labour productivity is measured at three-year sub-periods: 1991–93, 1994–96, 1997–99, 2000–02, 2003–05, 2006–08, 2009–11, and 2012–14.

Source: Author's construction based on ILO (2019), IMF (2019), UN Statistics Division (2019), and World Bank (2019).

Table A2: Labour productivity growth, structural transformation, and economic openness in SSA, 1991–2015: LSDV estimation (robustness test with three-year sub-period interval)

	(1)	(2)	(3)	(4)	(5)
	Growth of labour productivity	Growth of labour productivity	Growth of labour productivity	Growth of labour productivity	Growth of labour productivity
Lagged growth of labour productivity	0.065 (0.205)	0.061 (0.194)	0.006 (0.197)	-0.082 (0.183)	-0.087 (0.188)
Log of initial level of labour productivity	-0.046 (0.034)	-0.045 (0.033)	-0.057 (0.040)	-0.036 (0.037)	-0.034 (0.036)
Log of share of total employment in agriculture	-0.061 (0.040)	-0.065 (0.040)	-0.049 (0.046)	-0.069 (0.048)	-0.063 (0.043)
Log of share of total employment in industry	0.003 (0.032)	0.003 (0.035)	-0.014 (0.033)	-0.029 (0.028)	-0.027 (0.029)
Log of share of total employment in services	0.047 (0.054)	0.049 (0.052)	0.068 (0.046)	0.018 (0.043)	0.014 (0.040)
Log of total capital Stock		-0.004 (0.013)	-0.079** (0.031)	-0.040** (0.016)	-0.041** (0.016)
Log of total exports			0.001 (0.044)	-0.006 (0.039)	-0.005 (0.039)
Log of total imports			0.099** (0.047)	0.072 (0.046)	0.074 (0.046)
Net inflow of FDI				0.011*** (0.003)	0.011*** (0.003)
Capital account openness					0.020 (0.028)
Dummy 2001–05	-0.019 (0.047)		-0.028 (0.042)	-0.012 (0.030)	-0.012 (0.030)
Dummy 2006–10	-0.010 (0.045)		-0.042 (0.040)	-0.027 (0.029)	-0.027 (0.029)
Dummy 2011–15	0.015 (0.046)		-0.029 (0.041)	-0.033 (0.032)	-0.032 (0.033)
Observations	164	164	164	164	164
R-squared	0.038	0.034	0.134	0.316	0.318
Country fixed effects	No	No	No	No	No
Period fixed effects	Yes	Yes	Yes	Yes	Yes

Notes: Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Growth of labour productivity is measured at five-year sub-periods: 1991–93, 1994–96, 1997–2000, 2001–03, 2004–05, 2006–08, 2009–11, and 2012–14.

Source: Author's construction based on ILO (2019), IMF (2019), UN Statistics Division (2019), and World Bank (2019); and the Chinn–Ito index (Chinn and Ito 2008).