The paper on: Analysis of recent evolution of economic sectoral output, employment and structural economic transformation in EAC: Spatial panel data approach (1991-2018);

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Abstract

This paper examines the effect of a variate of drivers of economic growth in East African Community (EAC) countries from 1991 to 2018. Different researches have been criticizing the reallocation of economic activities in different sectors of the economy in the southern hemisphere, especially in sub-African countries. This paper is devoted to the recent evolution of the sectoral output level and employment in East African Community countries, assessment of causes and covariates that are correlated, and which might help us to predict output across countries and over time in EAC. We have modeled sectoral output in EAC using the spatial panel approach. We have empirically illustrated spatial Durbin model using the space-time data for output (GDP per capita), sectoral employment share, labor force and final consumption expenditure over 28 years from 1991-2018, where the motivation for spatial dependence is a bootlegging effect (see Debarsy et al., 2010) where buyers either of agricultural products, manufactured products, and different services near country borders purchase in neighboring country if there is a price advantage to doing so.

Keywords*: Economic sectors, Structural transformation, spatial panel approach*

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1. Introduction

Sub- Saharan African continent in general since 2000, it has been seen high increase in commodity prices which led to high escalation in raw-materials exports revenues, high relocation of people from rural areas to urban regions, and construction booms (Busse et al., 2018) showing the significance of reallocation of economic activities in different sectors of the economy in economic growth of African countries.

East African community countries have too experienced such tremendous economic growth mainly driven by service and agriculture, for example, the average economic growth rate between 2008 and 2018, were 7.57 percent in Rwanda, 6.18 percent in Tanzania, 5.14 percent in Kenya, and growth from these countries were the highest among African countries.

Despite impressive economic growth in last decade, reallocation of economic resources across sectors of the economy is quite deficient among east African community countries, for example in 2018, from the composition of GDP in the region, service sector headed with 59.0 percent, followed by agriculture sector with 25.7 percent, and lastly industry sector with 15 percent, in addition to this the average share of manufactured exports was about 14.6 percent (African Development Bank [ADB], 2019).

To achieve sustainable economic growth in East African community countries, there is a need of strengthening the linkages running from agriculture sector through industry to service sector, Agriculture continues to be a key player in creating jobs, food security, and providing sources of inputs for large part of infant industries in East African region, on average 71.8 percent of labor force in Rwanda was working in agriculture sector between 2008 and 2018, all most the same percentage or lower in other countries in the region, 91.7 percent in Burundi, 70.8 percent in Uganda, 68.6 percent in Tanzania and 58.8 % in Kenya.

The main objectives of this paper were divided into two; the first one was to explain how the patterns of structural transformation in EAC countries regions have evolved and the second one was to assess causes and covariates that are correlated, and which might help us to predict output across countries and over time in EAC countries.

The next part of this paper is structured as follows. The following part provides a literature review on economic sectoral output and structural transformation from a global view to EAC countries. The data and methods of the study are delineated next. Thereafter, the analysis of the results forms the next part. Then, we conclude the paper with recommendations.

2. Literature Review: Empirical studies on economic sectoral output and structural transformation

Analysis of sectoral composition (agriculture, agro-processing, industry, and service) and its contribution to economic development has been examined thoroughly since the pioneering work on the economic growth of Adam Smith (1776). Adam smith advocated freedom actions ideology of individuals in pursuing economic activities, and that free and independent actions of individuals would increase economic growth.

The wide function representing the relationship between inputs (like labor) and output (production) was developed jointly by Charles Cobb and Paul Douglas in 1928. From Giorno *et al*. (1995), the simplest Cobb-Douglass production function is of this form:

$$Y_t \; A_t \; {}_{.L} \; {}_{t} \; .K^{1} \; {}_{t}$$

Where $Y, A, L, and \; K$ are real GDP, factor productivity level, labor input, and capital input respectively and (1) 1

According to Rodrik (2013), most low-income countries in the southern hemisphere (Africa) have experienced fractional economic growth between the 1960s and 1970s due to industrialization squeezes, other countries, have experienced such growth from 1990 due to commodity booms and improved governance with a limited reallocation of resources. Capital formation was found also to have a positive significant effect on economic growth (Dritsakis *et al*, 2006; Perkins *et al*, 2006; Bal *Et Al*., 2016).

Sectoral composition and shift of economic activity are key to understand economic growth and development of countries as well as economic imbalances in terms of wage inequality and the business cycle (Herrendorf *et al*., 2013). Structural transformation is not only linked to the economic development of countries but also the change in inequality and urbanization (Timmer and Akkus, 2008; Michaels *et al*., 2012). According to Herrendorf *et al*. (2013), structural transformation refers to "the reallocation of economic activity across the broad sectors agriculture, manufacturing and services", and the most common measure of economic growth is GDP per capita, while there are three commonly measure of structural transformation of economic activity at sectoral level including final consumption expenditure shares, value-added shares, and employment shares.

Different authors argued that economic development gap between north hemisphere countries and south hemisphere countries comes from the fact that, south hemisphere countries are much less productive in agriculture and reallocation of economic activities in different sectors and high share of people working in agriculture sector (Caselli, 2005; Gollin *et al*., 2007; Restuccia *et al*. 2008).

Fisher (1935) and Clark (1940) affirmed the role of structural transformation to the economic growth of countries, as they have observed that reallocation of resources from the agriculture sector to services sector to be accompanied by higher GDP per capita (Kim, 2006).

Different authors have extensively claimed non-consideration of spatial interdependence across-countries would lead to model misspecification in understanding economic growth of countries, starting from Ramírez and Loboguerrero (2002) have modeled economic growth by considering cross-country interdependence based on 98 countries, and their results suggested that "spatial relationships across countries are quite relevant. A country economic growth is indeed affected by the performance of its neighbors and therefore it is influenced by its geographical position", in additional Lima and Neto (2018) have included spatial independence across regions in their study on economic growth based on theoretical model Mankiw-Romer-Weil and have estimated Spatial Durbin Model with fixed effect for period between 1970 to 2010, as results they have found "a strong spatial dependence among Brazilian micro-regions, moreover, there was evidence that both investments in physical capital and investment in human capital matter not only for the growth of the economy itself but also the growth of neighboring economies.", then, Hall et al., (2018), argued that "neglecting to account for spatial autocorrelation can bias estimation results and therefore inferences are erroneous" .

However, there is no conclusive research examining the causes and covariates that are correlated, and that might help us to predict output across countries and over time in EAC countries.

3. Data and Methods

The sample for our study covers panel observations for 5 East African Community (EAC) countries (Burundi, Rwanda, Uganda, Tanzania, and Kenya) throughout 1991 – 2018. Excluding South Sudan as it is recently admitted to EAC. The current paper only focuses on balanced panels, as we have used 28-time series and 5 countries, to have 140 observations. Panel Dataset used in this paper was composed from World Bank website; follow this link to get data: https://microdata.worldbank.org/index.php/home.

Figure 1: EAC Block excluding South Sudan

From Anselin et al. (2008), a spatial panel data model may be specified as the spatial lag model or the spatial error model, the first model, is when a spatially lagged dependent variable is stated, while in the second model is when a spatially autoregressive in the error term is stated, given that geographic data tend to be spatially dependent as prior assumption, and the third model was developed to include both a spatially autoregressive in the error term, and a spatially lagged dependent variable (see LeSage and Pace, 2009).

In this paper, we have adopted the Spatial Durbin Model (SDM) developed from the Manski model and tested it against other simplest models by imposing restrictions.

Assumptions:

We have assumed that the output (measured here using GDP per capita) in-country in East African Community (EAC) might be related to the value of the output in a neighboring country (($LagY$) .

The value of covariates in-country (Eg. Rwanda) might be related to the value of the output in a neighboring country ($LagX$) . Eg. Tanzania.

Residuals might be related through countries

Inclusion of spatial interaction effects from the standard panel model is from the facts that,

Labors are expected to search jobs across countries(in the nearby country), legally or illegally, as long as they are getting better facilities, these can be salary advantages, transport facilities, high purchasing power

The highly populated country is expected to have more emigrants to a neighboring country Free movement of capital across industries and countries.

The choice of SDM depends on two main factors (see Le Sage and Pace, 2009), in case there are omitted variables, which are spatially autocorrelated, the SDM limits the bias effect, and it combines a SAR and SEM model: global and local spillovers (in other words SDM spillover effects are flexible).

$$Y_{ti} \quad WY_{ti} \quad X_{ti} \quad XW_{ti} \quad {}_{ti}, i \ 1,....., N; t \ 1,....., T, \ ..... \quad (1)$$

Whereas GDP Per capita (Y_{ti}) is the observation on the i^{th} country for the t^{th} period, stands for spatial autoregressive parameter, WY_{ti} stands for the spatially lagged output on the i_{th} country for the t^{th} period accounting for various spatial dependencies (country and time) with W defined as (n x n) spatial weights matrix (see figure 2) as distance between major cities in East African

Community Countries, WY_{ti} measures endogenous interaction effect, XW measures exogenous interaction effect, and $_{ti}$ is the regression disturbance.

In this paper, we have fitted both the Spatial Durbin model with country fixed effect and the Spatial Durbin model with country and time (two ways) fixed effect using Maximum Likelihood Estimation (ML), and random draws from a multivariate normal distribution were made from a variance-covariance matrix of the coefficients.

According to Lee & Yu (2010), spatial econometrics involves the application of econometrics techniques considering interactions of economic variables and physical units in space, space considered here are neighborhood countries in EAC (Figure 2).

Figure 2: Neighborhoods among EAC countries

For a spatial Durbin panel data model, a change in country characteristics not only has a direct influence on the outflows and inflows from and to this country but also has an indirect effect on the flows to and from other countries in the economic growth across countries and time. Therefore, there is a need to quantify various responses in the model considering both local and global effects (Golgher and Voss, 2016).

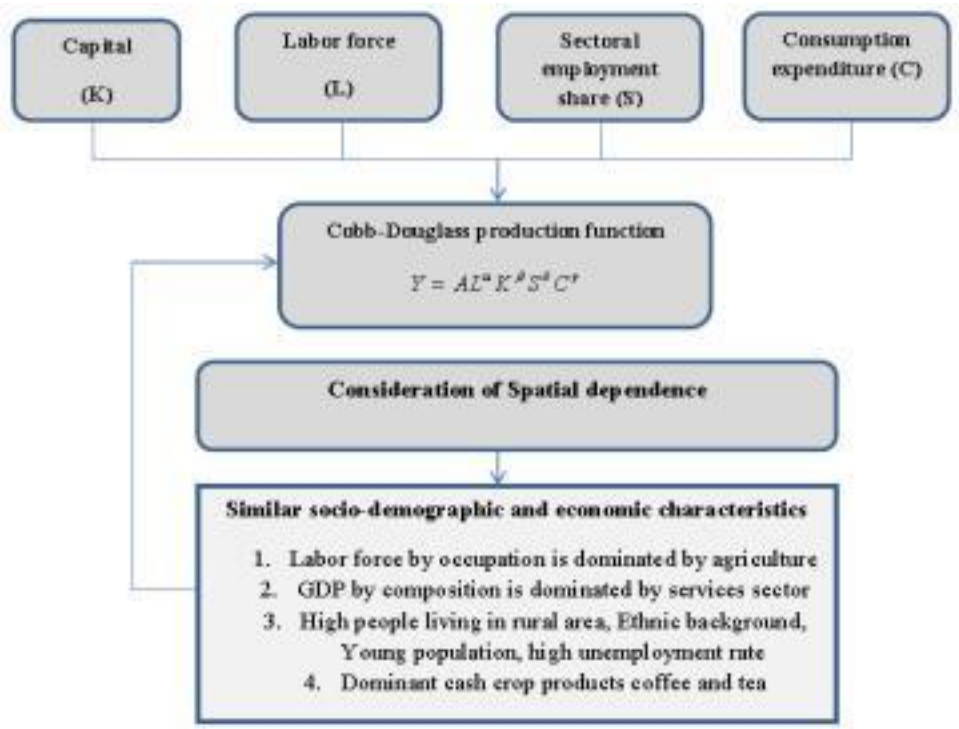
The conceptual framework presents a double growth model that includes spatial dependence throughout the productivity term. We assume the traditional Cobb-Douglass production function (Figure 3). Given the beliefs of spatial autocorrelation across countries in EAC, we first examined this belief through global Moran I for the GDP per capita.

$$I = \frac{n\sum_{i,j}^{n} w_{i,j} C_i Cj}{\sum_i \sum_j w_{i,j} \sum_{i=1}^{n} C_i^2}, i \# j, \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

C_i and C_j represents deviations from the means and are the observations on a variable (y) for the country i and j , respectively, In this case y , is a country's GDP per capita, If I 0 , then there is no indication of residuals spatial autocorrelation, that is, residuals tend to move independently. If Moran's I statistic is greater than zero, there is a positive spatial autocorrelation, that is, areas

with high residual values tend to be closer to areas with high residual values (and vice versa). Finally, if Moran's *I* statistic is smaller than zero, there is a negative autocorrelation; that is, places with high residual values are closer to neighboring places with low residual values, and vice versa(Resende, 2013).

Figure 3: Conceptual framework



Source: Researcher, 2020

Table 1: Description of variables

Variable	Description
GDP_per_capita	GDP per capita (Constant 2010 US$)
Capital_formation	Gross capital formation (Constant 2010 US$)
Employment_in_agriculture	Employment in agriculture (% of total employment)
Employment_in_industry	Employment in industry (% of total employment)
Employment_in_services	Employment in services (% of total employment)
Final_cons_exp	Final consumption expenditure (Constant 2010 US$)
Labour_force	Total labor force

Source: World Bank, 2019

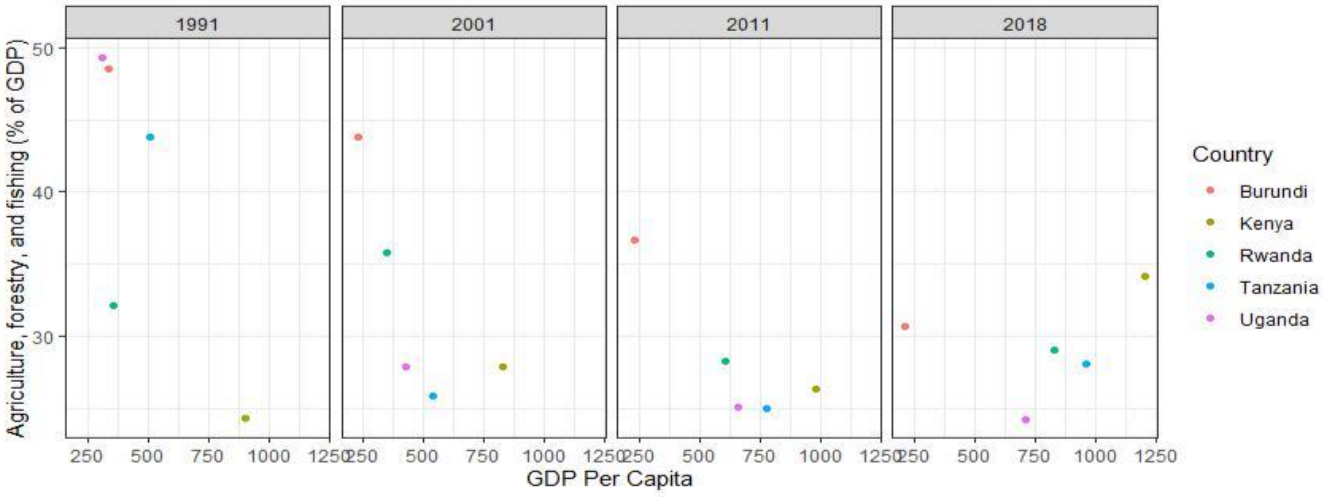
4. Results

4.1 Agriculture share of value-added and employment trend comparison in EAC countries, 1991 – 2018

Comparing East African Community peer group countries from 1991, Burundi and Uganda had a higher share of Agriculture, forestry, and fishing in GDP with percentages ranging between 48 and 49 with lower GDP per capita/year ranging between $250 and 500$ (Figurer 4, Panel A), and higher percentage of people employed in agriculture with values between 75 to 95 (Figurer 4, Panel B). Kenya had the lowest share of Agriculture, forestry, and fishing in GDP with 24 percent in EAC associated with higher GDP per capita/year more than $875, with a lower percentage of people employed in the agriculture sector (46%). For the two main indicators of structural transformation presented- agricultural value-added and share of employment in agriculture, higher employment in agriculture and higher share of agriculture, forest, and fishing in GDP was associated with lower GDP per capita in 1991, these situations have shifted, for example in Kenya higher GDP per capita increased further to more than $1200, and rest of East African countries have shifted from less than $500 GDP per capita/year to more than $500 GDP per capita/year except Burundi, from Figure 4, Panel A, it is clear that share of agriculture, forest, and fishing have been downward converging to Kenya as leading economy in EAC and employment in agriculture as percent of total employment has been reduced over time.

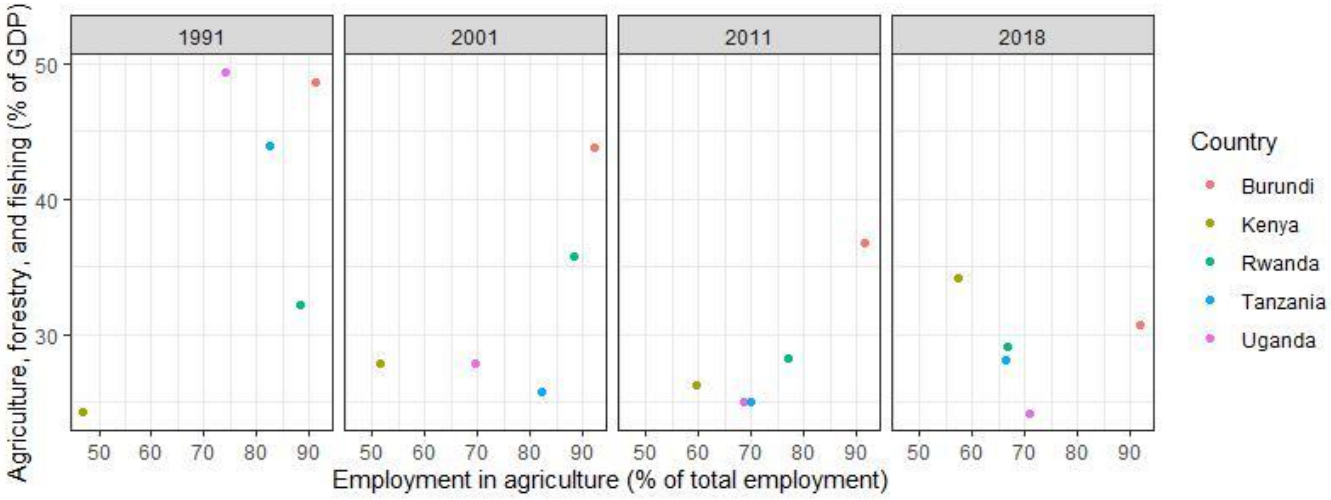
Figure 4: Agriculture share of value-added and employment trend comparison in EAC countries, 1991 - 2018

Panel A



Source: Researcher, 2020

Panel B



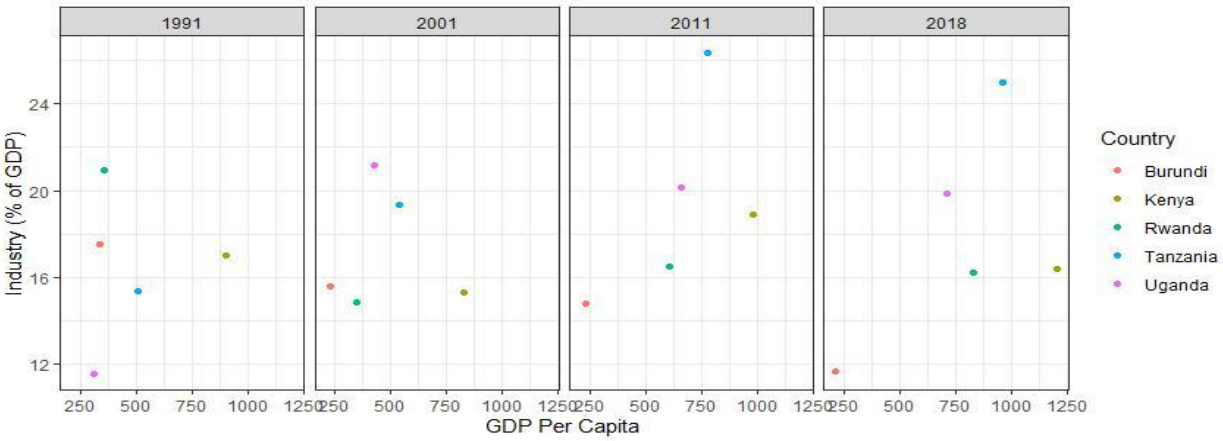
Source: Researcher, 2020

4.2 Industry share of value-added and employment trend comparison in EAC countries, 1991 – 2018

Comparing East African Community peer group countries from 1991, it is clear that share of services in GDP have been converging in center, meaning country like Kenya, it's contribution declined while countries like Tanzania and Uganda, their contribution increased from 1991 to 2018 (Figure 6, Panel A), and that the lower share of people working in the service sector was associated with a lower share of service in GDP in 1991, and a higher share of people working in the service sector was associated with a higher share of service in GDP in 2018 (Figure 6, Panel B).

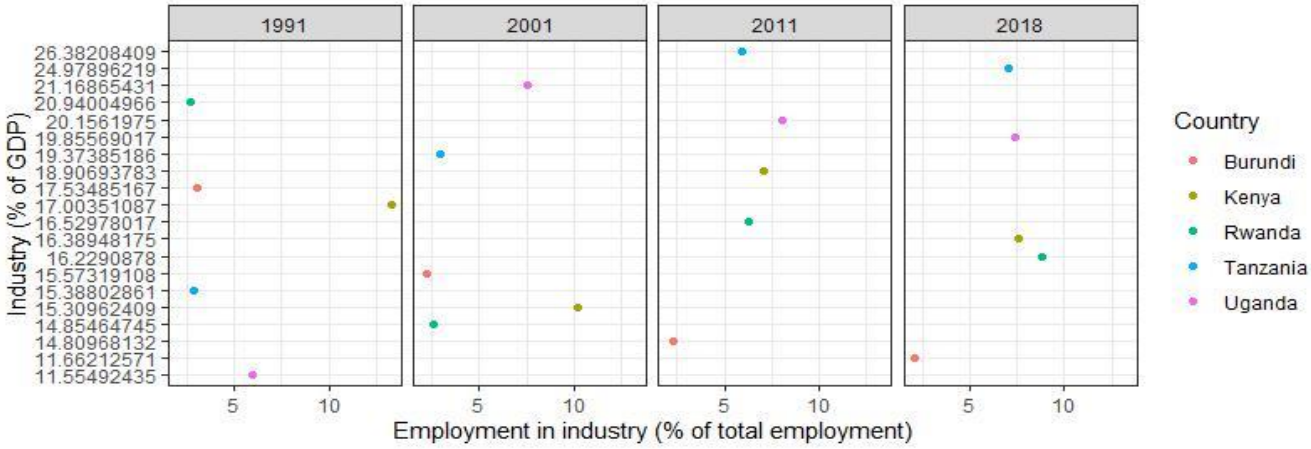
Figure 5: Industry share of value-added and employment trend comparison in EAC countries, 1991 - 2018

Panel A



Source: Researcher, 2020

Panel B



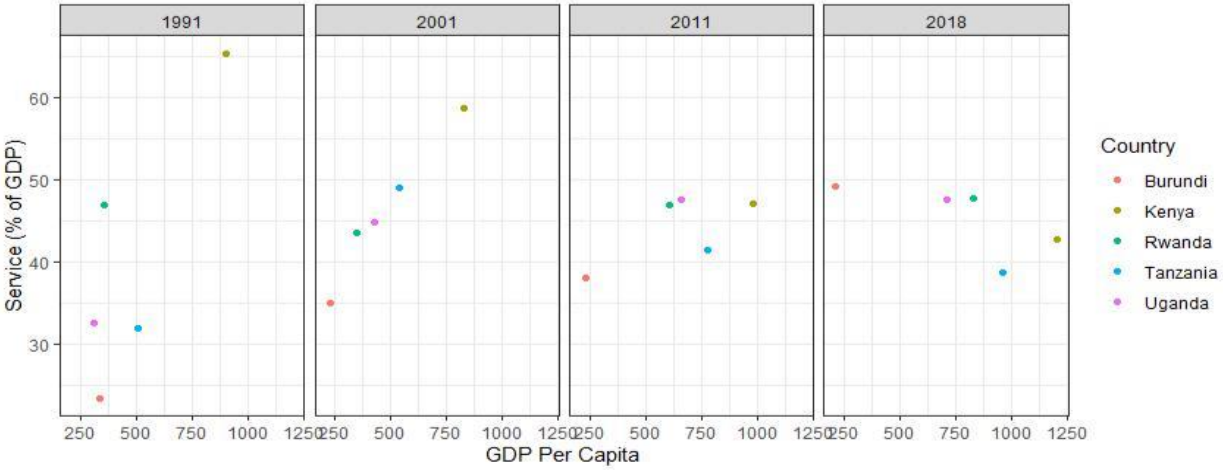
Source: Researcher, 2020

4.3 Service share of value-added and employment trend comparison in EAC countries, 1991 - 2018

Comparing East African Community peer group countries from 1991, it is clear that share of services in GDP have been converging in center, meaning country like Kenya, it's contribution declined while countries like Tanzania and Uganda, their contribution increased from 1991 to 2018 (Figure 6, Panel A), and that the lower share of people working in the service sector was associated with a lower share of service in GDP in 1991, and a higher share of people working in the service sector was associated with a higher share of service in GDP in 2018 (Figure 6, Panel B).

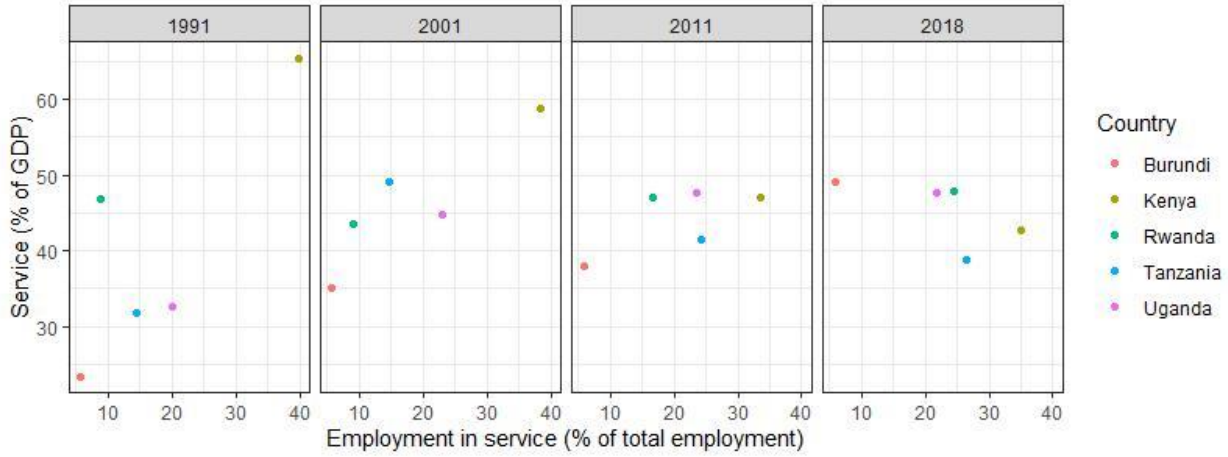
Figure 6: Service share of value-added and employment trend comparison in EAC countries, 1991 – 2018

Panel A



Source: Researcher, 2020

Panel B

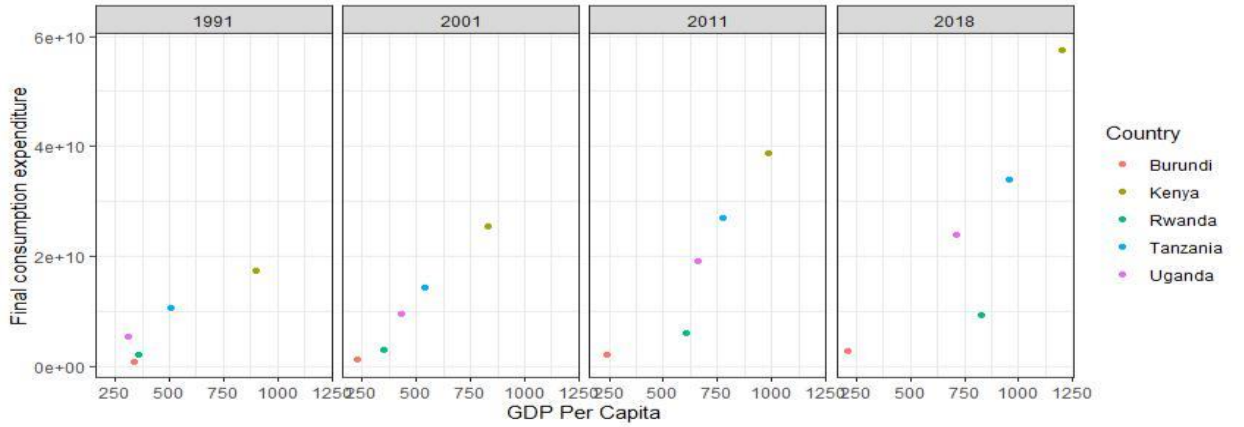


Source: Researcher, 2020

4.4 Final consumption expenditure trend comparison in EAC countries, 1991 – 2018

Comparing East African Community peer group countries from 1991, it was observed that final consumption expenditure in East African countries has shifted at the same pace but in the stair, format showing an acceleration in gap consumption between countries from 1991 to 2018 (Figure 7).

Figure 7: Final consumption expenditure trend comparison in EAC countries, 1991 – 2018



Source: Researcher, 2020

4.5 Spatial Durbin regression results

Table 2: Spatial Durbin model with country fixed effect (1) Vs Spatial Durbin model with c ountry and time (two ways) fixed effect (2)

	Dependent variable: log(GDP_per_capita)	
	(1)	(2)
log(Capital_formation)	0.096349 (3.9601***)	0.073889 (3.0471**)
log(Employment_in_agriculture	0.786510 (3.6755***)	0.095220 (0.3368)
log(Employment_in_industry)	0.623598 (9.4588***)	0.440219 (6.2883***)
log(Employment_in_services)	0.183087 (2.3171*)	0.291041 (2.4310*)
log(Final_cons_exp)	0.159908 (2.1820*)	0.087329 (0.263344)
log(Labour_force)	0.650811 (4.9886***)	0.957469 (3.9154***)
log(GDP_per_capita_lag)	0.043877 (0.3057)	-0.610104 (-1.6248)
log(Capital_formation_lag)	-0.020001 (-0.3459)	-0.035700 (-0.3443)
log(Employment_in_agriculture_lag)	-0.116612 (-0.1849)	-0.677955 (-1.1268)
log(Employment_in_industry_lag)	0.015298 (0.1235)	-0.072517 (-0.2943)
log(Employment_in_services_lag)	1.491347 (6.7259***)	1.802978 (4.6576***)
log(Final_cons_exp_lag)	-0.710816 (-4.1252)	-0.722559 (-2.5894**)
log(Labour_force_lag)	-0.020341 (-0.0812)	1.264986 (1.9517)
Observations	140	140
R^2	0.9984232	0.9988142
Adjusted R^2	0.9898266	0.9923492
LogLik	125.5189	144.6433
Akaike Criterion (AIC)	-211.0378	-197.2866
Scharz Criterion (BIC)	-152.205	-61.97105

Signif. Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1 *Notes:* All variables are in log form, t-statistics in par entheses

Source: Researcher, 2020

Table 2 reports the estimation results when adopting the spatial lag of output (GDP per capita) by considering, first, country fixed effect, then, second by considering both countries' fixed effect an d time fixed effect. The second column presents the results of the spatial lag of GDP per capita m odel with country fixed effects, while the third column presents the results of the spatial lag of G DP per capita model with both country fixed effects and time fixed effect.

If we compare the results in the second column with those in the third, we see that the point estim ate of the spatially lagged value of GDP per capita changes sign when controlling for both countr y and time-period fixed effects, but the coefficient estimate remains insignificant. These results c

orrespond to the one obtained by Pintar *et al*., (2016) in studying outbound foreign direct investm ent in Europe.

Turning to the variables of major interest, we find the coefficient on the spatially lagged value of all explanatory variables to be negative and insignificant except employment in service (% of tota l employment) which was found to be positive and significant and the coefficient of the final con sumption expenditure which was found to be negative and significant. The consequence of the int eractions in SDM is that a covariate unit change in the spatial coefficient of the lagged response w hich is non-zero will have global spillovers impacts, so there is need of caution in interpreting the results, in this case, impacts should be interpreted rather than the regression coefficients, while in case of the spatial coefficient of the lagged response is zero a covariate unit change will have an i mpact on the response (Elhorst 2010; LeSage 2014). To avoid invalid conclusion, we have used d irect, indirect and total impact from table 3 to report global spillovers impacts of employment in s ervices as percent of total employment and the final consumption expenditure in EAC countries.

Table 3: Direct, indirect and total impacts on EAC countries growth

	Direct	**Indirect**	**Total**
log(Employment_in_services)	0.15304 (2.1702***)	0.24566 (2.754***)	0.3987 (5.47122***)
log(Final_cons_exp)	-0.12563 (3.453***)	-0.33412 (-1.2345)	-0.45975 (-1,768)

Source: Researcher, 2020

The numbers are obtained using the distance weight matrix, the standardized deviations and z values are obtained by assuming normal distribution and using simulation.

5. Conclusion and Recommendations

This paper examined the recent evolution of the sectoral output level and employment in East African Community countries for each 10 years (1991, 2001, 2011, and 2018), then it uses spatial Durbin model to estimate Cobb-Douglas model to predict output across countries and over time in EAC, in which a country's economic growth here measured using GDP per capita depends on the neighbors' economic growth and other covariates within country and neighbors. Based on a sample of 5 East African Community countries over 28 years (from 1991 to 2018) the paper finds some interesting results.

First, 1991, the majority of EAC countries (Uganda, Burundi, and Tanzania) were characterized by higher people employed in agriculture more than 75 percent of total employment coupled with higher share of agriculture sector in GDP (40 % to 50 %) but this has evolved and countries like

Rwanda, Tanzania, and Uganda in 2018, have seen their share of added-value of agriculture in GDP declined to less than 30 percent, and people employed by agriculture sector declined to less than 70%.

Nevertheless, the agricultural sector continues to employ most of the labor force in East African community countries; our results reveal that reallocation of economic activities have been from primary sector to services sector, implying wrong structural economic transformation. This result complete the one founds by Busse et al., (2018).

In order to revise this channel from reallocation of economic activities from primary sector to tertiary sector by strengthening manufacturing sector in between there is need of capacity building of small scare industries, More efforts in trainings at household level in creative skills (leather shoes, paper bags, bakery, paintings, agro-processing ...), and More efforts in free trade areas between East African Countries

Second, Comparing East African Community peer group countries from 1991, it was found out that EAC countries' share of services in GDP have been converging in middle, as country like Kenya has seen its contribution of services sector in GDP declined, while other countries like Tanzania and Uganda, have seen their contributions increase from 1991 to 2018.

Third, as policy implication, our results reveal that a country's economic growth is affected by the performance of its neighbors, where the results suggested the spillover effects from employment in service as a percent of total employment and the final consumption expenditure.

Even if we have found interesting results, our results need to be interpreted with caution, as the panel data period was very short, and second spatial panel approaches still have some limitations.

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