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Regional and subregional analyses of macroeconomic policy strategies for growth and equality in Southern Africa

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Abstract: We investigate the relevance of beta (β, absolute and conditional) and sigma (σ) convergence in the economies of the Common Monetary Area of Southern Africa and in the provinces of the Republic of South Africa using panel data, allowing an understanding of growth and inequality in the region. The region has experienced β- and σ-convergence; however, growth rates of per capita gross domestic product are low at aggregate and sectoral levels. At sectoral level, the performance of the tertiary sector is better than that of the primary and secondary sectors. The relatively poor performance of the primary and secondary sectors needs policy attention. For the provinces of South Africa, capital expenditure on key sectors such as education and health can enhance growth rate, whereas the overall revenue expenditure retards growth. Therefore, provinces' capital budgets need to be managed well within the limitation of revenue expenditure to avoid fiscal imbalances.

Key words: convergence, growth, inequality, panel data, Southern African region

JEL classification: C23, D63, E13, O47, R11

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1 Introduction

Growing regional economic inequality, with considerable variations in growth across different boundaries, is a matter of policy concern in many areas, and the Southern African (SA) region led by the Republic of South Africa (RSA) is not an exception. The African Development Bank (AfDB 2020) has predicted that the growth of the economy of the RSA will rebound to 3 per cent in 2021 from a −3.4 per cent level, which is the worst-case scenario for 2020 due to the coronavirus disease pandemic (COVID-19). Similarly, the Bank of Namibia (BoN 2020) has projected that the economy of Namibia (a member of SA) will contract by 6.9 per cent in 2020 and its growth rate could be −1.8% in 2021. The region was going through a period of economic turmoil even before the COVID-19 shocks, with a high debt-to-GDP ratio, low and/or negative growth rate of GDP, high unemployment, and poor overall macroeconomic fundamentals. Barro (1999) has mentioned that one of the impediments to higher economic growth in poorer economies is inequality, though in richer economies this is not the case, justifying the empirical presence of the Kuznets curve. This concept of inequality is at the micro level of individuals and households, but inequality among regions is sometimes associated with growth performance, especially when the regions are connected through a common economic, geopolitical, or social fabric. The economies of the SA region—which are basically the members of the Southern African Common Monetary Area (CMA), namely the RSA, Namibia, Lesotho, and Eswatini—are also experiencing low growth rates. In fact, the slow growth rate of the region for quite some time and predicted negative growth rate of the hegemonic economic power of the region, i.e. the RSA, are the major motivations behind studying the interrelationship between growth and (in)equality in the region.

Many factors influence regional development patterns: natural endowment, mobility of factors of production, stage of economic development, quality of governance, and economies of scale leading to specialization. Balanced regional development has been a touchstone for policy evaluation in South Africa, but Fintel (2018) has ascertained that agglomeration and historical institutional failures are the main reasons for spatial/regional inequality in the RSA. Similarly, Gelb (2004) and Woolard (2002) have acknowledged the presence of absolute income divergence in the region. The studies on income divergence/convergence in the literature are largely based on the concept of beta (β) and sigma (σ) convergence (discussed in Section 2) developed by Barro and Sala-i-Martin (1992) and recently on club convergence, which is based on the Solow-Swan growth model (Solow 1956; Swan 1956).[1] The notion of income convergence stems from the neoclassical growth model, which assumes constant returns to scale, constant saving ratio, and diminishing return to factor inputs (due to the Ínada condition). It predicts that in the absence of technological progress (where growth is thus due purely to capital accumulation), whether an economy is defined as poor or rich in terms of its level of per capita income, then the initial per capita income will be inversely related to growth rates. However, the Solow-Swan growth model does not account for the effect of policy changes (Jena and Barua 2020). On the other hand, the notion of conditional convergences as discussed by Barro and Sala-i-Martin (1992) accounts for other factors in addition to policy and institutional variables. In fact, the literature on the convergence hypothesis of Barro and Sala-i-Martin (1992) explains the differences in levels and growth rates of income across different economies or regions in an economy (to cite a few among others, Purfield 2006; Rao et al. 1999; Sachs et al. 2002; Trivedi 2003). A few studies have found evidence of absolute divergence with

[1] However, there are other classifications of the concept of convergence in the literature—see Islam (2003); Kumo (2011).

conditional convergence (see among others, Chakraborty and Chakraborty 2018; Cherodian and Thirlwall 2015; and Sofi and Durai 2017).

The issue that emerges from the findings of these studies is that conditional convergence depends on various factors, such as urbanization, access to the sea, and climatic variability, in addition to endowments, institutions, and policies. It is in this context, without diminishing the contributions of the above-cited empirical studies, that the present study examines the convergence and/or divergence of income across the economies of the members of the CMA. This study also examines growth and inequality, in light of Barro and Sala-i-Martin (1992), at the subregional, i.e. provincial, level in the RSA (there are nine provinces in the RSA, namely Eastern Cape (EC), Free State (FS), Gauteng (GA), KwaZulu-Natal (KN), Limpopo (LI), Mpumalanga (MP), Northern Cape (NC), North West (NW), and Western Cape (WC)), the hegemonic economic and financial power within the CMA, and the resulting importance of macroeconomic policy issues. The remainder of the paper is arranged as follows: the next section discusses both theoretical and empirical literature on the convergence hypothesis; the third section develops the analytical framework; the fourth section discusses the variables and data sources; and the results are discussed in the fifth section. The final section concludes the paper with some policy suggestions.

2 Review of literature on beta (β) and sigma (σ) convergence: the concept

The neoclassical economic growth theory of Solow (1956) and Swan (1956) forms the basis of the convergence hypothesis. It predicts that regional differences in per capita income tend to be reduced over time, provided that the initial structures of the regional economies are similar, largely due to the Ínada condition.[2] However, endogenous growth theories (Lucas 1988; Romer 1986) suggest that technological progress can offset the Ínada condition and the neoclassical prediction of convergence may not be realized. Early studies tried to test the convergence hypothesis and came to mixed conclusions across different regions and/or subregions over different time periods (Barro and Sala-i-Martin 1995; Baumol 1986; Lucas 1988; Mankiw et al., 1992).

However, the concept of convergence as developed by Barro and Sala-i-Martin (1991, 1992, 1995) postulates two types of convergence, namely β (beta) and σ (sigma): β-convergence discusses whether economies with lower capital per person tend to grow faster in per capita terms. The supposition that without conditioning on any other variable(s) or features or the structure of economies, poor economies tend to grow faster than their richer counterparts, is known as absolute β-convergence. This predicts a negative correlation between initial per capita income and the growth rate of an economy. However, the empirical results of Barro and Sala-i-Martin (1995) postulate the prevalence of absolute β-convergence for a group of homogeneous economies, not for heterogeneous economies. Their empirical results support the presence of absolute β-convergence for 20 economies of the Organisation for Economic Co-operation and Development (OECD) over the period 1960–85, justifying the prevalence of the hypothesis within the group of homogeneous economies, whereas the results for 118 other countries for the same period revealed a slight positive correlation of growth rates with the initial economic position, contrary to the postulation of absolute β-convergence. However, the authors also concluded that by allowing for heterogeneity across economies (specifically, if the assumption of the same economic structure and parameters and therefore the same steady-state position across economies is dropped), one can inculcate the empirical observation into the convergence hypothesis, i.e. in the form of

[2] The Ínada condition predicts a diminishing return to the factors of production.

conditional β-convergence (the idea that economies grow faster the farther they are from their own steady-state value; Barro and Sala-i-Martin 1995).

The steady-state value of an economy depends on the rate of savings, the level of the production function, and the government policies, institutions, and organizations that can influence the production system. The hypothesis of conditional β-convergence suggests that in order to explore the predicted inverse relationship between the initial economic positions (in terms of low or high income per capita) and the growth rates of economies, these determinants of steady-state values need to be controlled or kept constant. If the parameters affecting steady-state value are uncontrolled, then one may empirically experience β-divergence. As Barro and Sala-i-Martin (1995: 30) state:

> Moreover, the countries with low starting levels … are likely to be in this position precisely because they have low steady-state values, … perhaps because of chronically low saving rates or persistently bad government policies that effectively lower the level of production function.

They also conclude that the inclusion of explanatory variables which represented the differences in the steady-state positions across economies in the empirical models suggested the prevalence of conditional β-convergence.

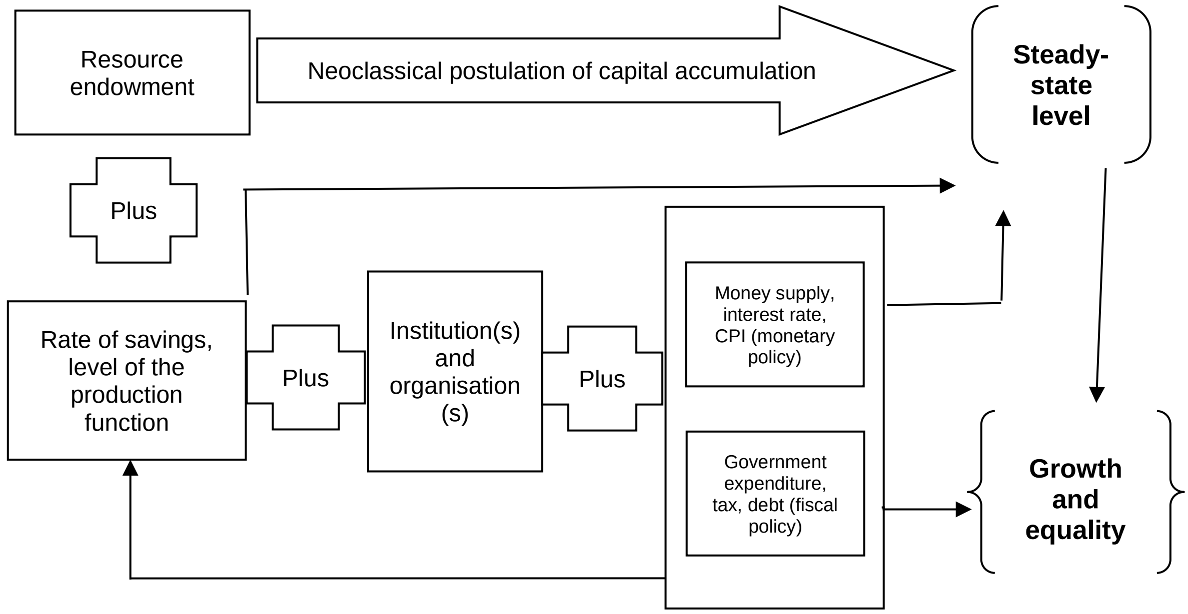
The other concept of convergence postulated by Barro and Sala-i-Martin is σ-convergence, which tries to address the issue of reduced income inequality across economies and/or regions over time. The σ-convergence tests whether the dispersion of real per capita income across economies (income inequality across regions) is falling over time or staying steady. Development theories in early writings focused on economic inequalities, specifically income inequalities, and are of the opinion that economic growth is an elevator for the reduction of income inequality at micro level (Kuznets 1955; McKinley 2009). Similarly, at the regional level, the precondition for the prevalence of σ-convergence is the existence of β-convergence. But this does not necessarily mean that if poor economies grow faster than their richer counterparts (in absolute and/or conditional terms), inequality will decline over time across economies. Further, Barro and Sala-i-Martin (1995: 31) state:

> Our concept of convergence is that economies with lower levels of per capita income (expressed relative to their steady-state levels of per capita income) tend to grow faster in per capita terms. This behaviour is often confused with an alternative meaning of convergence, that the dispersion of real per capita income across a group of economies tends to fall over time. We will show that even if absolute convergence holds in our sense, the dispersion of per capita income does not necessarily tend to decline over time.

Thus, higher growth rates of poorer economies compared with richer ones (β-convergence) should not be confused with the declining of inequality between rich and poor economies (σ-convergence). In fact, the former is just a precondition for the latter. Hence, β-convergence is a necessary but not a sufficient condition for the prevalence of σ-convergence (Quah 1995; Sala-i-Martin 1996).

The foregoing analysis of the conceptual framework can be explained through Figure 1. The figure shows that saving rate, production function, institutions, and policies will affect the steady state as well as the growth of an economy. However, as specified earlier, neoclassical growth models predict that it is capital accumulation that can affect the steady state. Thus, as per the Barro and Sala-i-Martin postulation, the conditional variables (including the policy variables) could be used to achieve β-convergence (absolute/conditional), the precondition for σ-convergence (i.e. reduced inequality) across economies.

Figure 1: The interrelationship between resource endowment, saving, level of production function, institutions, and policies towards growth and equality



Source: authors' construction based on literature review (Section 2).

There have also been a couple of studies that have explored inter-regional convergence at different times with different sample regions, with mixed results (Dey 2015; Mahapatra et al. 2019; Singh et al. 2014; Young et al. 2008). However, the empirical literature in some cases supports the notion of σ-convergence, i.e. reduced economic inequality across economies over time (Hobijn and Franses 2003; Kumar et al. 2018; Mahapatra et al. 2019; Malinen 2010, 2013; Mathur 2005; Wu 2006). Studies on African regions with varying samples have come out with mixed results on convergence, e.g. Hammouda et al. (2007), studying the African Regional Economic Community, (AREC), report convergence; Charles et al. (2012), looking at the Common Market for Eastern and Southern Africa, (COMESA), find no evidence of convergence; Aboagye and Turkson (2014) and Huffman and Huffman (2018) establish per capita income divergence in Sub-Saharan Africa, (SSA); Kant (2019) and Tegoum et al. (2013) observe convergence in homogeneous African economies; Khan (2014) finds conditional β-convergence in 32 African economies; and Djennas and Ferouani (2014) show weak absolute and conditional β-convergence and σ-convergence in Africa for the period 1980–2011.

A study by Rey and Deisting (2012) concludes that there is a lack of evidence of convergence in any form in 53 African countries over the period 1950–2008. Similarly, a study by Nell (2020) finds the absence of conditional convergence in 84 countries (including countries in Africa) in the post-1989 globalization period. Yadavalli (1998) asserts that the SA region experienced convergence during 1970–94. A study by Kumo (2011) on the South African Development Community (SADC) during 1992–2009 finds no evidence of absolute β-convergence or σ-convergence, but a study by Dunne and Masiyandima (2017) reports that bilateral foreign direct investment (FDI) between the RSA and the economies of the SADC region promotes per capita income convergence, a case of conditional β-convergence. Similar results have also been observed by Kweka et al. (2006) in the SADC region. On the other hand, the Economic Community of West Africa (ECOWAS) experienced both β- and σ-convergence (Jones 2002). However, the pre- and post-ECOWAS analysis of Anoruo (2019) reports divergence of income per capita in the ECOWAS region for the period 1960–2014. Wane (2004) finds a prevalence of the convergence hypothesis in West African Economic and Monetary Union (WAEMU) countries. At the provincial/subregional level in the RSA, Ringeta (2017), using panel data from 1995 to 2015, finds the presence of β-convergence, though the convergence is more rapid among the homogeneous provinces, as established by Barro and Sala-i-Martin (1995). Further, the study concludes that inequality may rise in the provinces of the RSA, a situation of σ-divergence.

In a comment, Kalirajan (2003) has mentioned that 'Regional balance in economic growth is a crucial issue, particularly for countries that have experienced dramatic economic changes', and suggested that the key task is to disentangle the differences in regional economic growth that arise from 'natural advantages' (location, resources, climate, etc.) and from differences in economic policies. Such disentanglement has not been done effectively in earlier empirical studies examining the convergence hypothesis in the CMA in general or in the RSA, creating a gap in the literature. The proposed study is an endeavour towards bridging this gap. However, before analysing the concept of β- and σ-convergence in the economies of the CMA and in the provinces of the RSA, it is pertinent to present the analytical framework, variables, and sources of data for the study, which we do in the following section.

3 The analytical framework[3]

The theoretical and empirical literature discussed in the previous section can be explained, in line with Barro and Sala-i-Martin (1992), using the production function as follows:

$$\hat{y} = f(\hat{k}) \tag{1}$$

Where $\hat{y}$ and $\hat{k}$ are output and capital per unit of effective labour. The effective labour force is given by Le^{xt}, L is the population and x is labour-augmenting technological progress, which is exogenously determined. Under the assumptions of a fixed rate of depreciation, δ, per capita consumption as $\hat{c} = C/Le^{xt}$ (C is the total consumption), and exogenously determined growth of the labour force at a rate n, the time derivative of $\hat{k}$ is given by:

$$\dot{\hat{k}} = f(\hat{k}) - \hat{c} - (\delta + x + n)\hat{k} \tag{2}$$

for a representative household that intends to maximize the infinite-horizon utility function,

$$U = \int_0^\infty u(c)e^{nt}\, e^{-\rho t}dt, \tag{3}$$

where $c = C/L$, ϱ is the rate of time preference, and

$$u(c) = {\{c^{(1-\theta)} - 1\}}\big/{(1-\theta)} \tag{4}$$

with the assumption of constant elasticity to marginal utility, i.e. to $u'(c)$, which implies $\theta > 0$. The Hamiltonian first-order maximization condition for the utility function gives

[3] This section of the paper is largely derived from the work of Barro and Sala-i-Martin (1992, 1995).

$$\frac{\dot{c}}{c} = \left(\frac{1}{\theta}\right) \times [f'(\hat{k}) - \delta - \rho] \tag{5}$$

and the level of $\hat{k}$ in the steady-state satisfies

$$f'(\hat{k}^*) = \delta + \rho + \theta x, \tag{6}$$

where $\hat{k}^*$ is $\hat{k}$ at steady state, and at that level the per capita y, k, and c grow at the rate of labour-augmenting technological progress, i.e., x. Barro and Sala-i-Martin (1992) assert that the growth rate of capital per worker ($\dot{k}/k$) declines towards the steady state, and with the Cobb-Douglas (C-D) production function (as in Equation 7) this property can be extended to the growth rate of output, i.e. ($\dot{y}/y$). This implies that for economies with the same parameters (without conditioning on any characteristics of the economies), the growth rate is larger for those economies with a lower initial capital–labour ratio—a case of absolute β-convergence. However, with the C-D production function as follows:

$$\hat{y} = f(\hat{k}) = A\hat{k}^{\propto}, \tag{7}$$

where the value of α lies between 0 and 1, the log linearization of the output with C-D technology gives

$$log[\hat{y}(t)] = log[\hat{y}(0)] * e^{-\beta t} + log(\hat{y}^*) * (1 - e^{-\beta t}), \tag{8}$$

where β is positive and determines the speed of adjustment to the steady state. This is given by

$$\beta = \frac{\left\{\varphi^2 + 4\left(\frac{1-\alpha}{\theta}\right)(\rho+\delta+\theta x)\times\left[\frac{\rho+\delta+\theta x}{\alpha} - (\rho+\delta+x)\right]\right\}^{\left(\frac{1}{2}\right)} - \varphi}{2}, \tag{9}$$

where $\varphi = \rho - n - (1-\theta)x > 0$. This implies that the values of α (the capital-share coefficient), ρ (rate of time preference, effectively the rate of saving), n (rate of growth of labour force/population), δ (rate of depreciation, of course assumed fixed), and x (the rate of labour-augmenting technological progress) affect the speed of adjustment (i.e. β) to the steady-state level. Equation 9 also shows that the efficiency parameter A from Equation 7 has no effect on the convergence coefficient β. Therefore, the β value may be similar across economies, even if their level of per capita output is different due to government policies and resource endowment. The average growth rate (AGR) of output between two time periods 0 and T is:

$$\frac{1}{T} * log\left[\frac{y(T)}{y(0)}\right] = x + \frac{1-e^{-\beta T}}{T} * log\left[\frac{\hat{y}^*}{\hat{y}(0)}\right] \tag{10}$$

This model of Barro and Sala-i-Martin shows that for a fixed rate of labour-augmenting technological progress and fixed level of steady-state output, the initial level of output, i.e., $y(0)$, and the AGR are inversely related—a case of conditional β-convergence.

For empirical analysis, the discrete time series annual data, the real per capita income of ith economy can be approximated as:

$$log\left(y_{it}/y_{i,t-1}\right) = a - (1 - e^{-\beta}) * log(y_{i,t-1}) + u_{it} \tag{11}$$

where a and β are constant, u_{it} is the random error term with 0 mean and variance as σ_{ut}^2, and $0 < \beta < 1$. A positive value of ' implies absolute β-convergence. To understand the σ-convergence,[4] we introduce the cross-section dispersion of per capita income, which is the variance of $\log(y_{it})$ at t, i.e. σ_t^2, which evolves over time as:

$$\sigma_t^2 = e^{-2\beta} * \sigma_{t-1}^2 + \sigma_{ut}^2 \tag{12}$$

Under the assumption of the constant variance of the disturbance term, i.e., $\sigma_{ut}^2 = \sigma_u^2$ for all t,[5]

$$\sigma_t^2 = \frac{\sigma_u^2}{1-e^{-2\beta}} + \left(\sigma_0^2 - \frac{\sigma_u^2}{1-e^{-2\beta}}\right) * e^{-2\beta t} \tag{13}$$

Equation 13 shows that positive value of β (β-convergence) does not necessarily mean the declining value of σ_t^2 (σ-convergence). Thus, it can be concluded that β-convergence is a necessary but not a sufficient condition for σ-convergence.

Based on the foregoing discussion, the estimable form of the model that tests absolute and conditional β-convergence can be expressed as follows:

For absolute β- convergence:

$$log(y_{it}/y_{it-1}) = \alpha + \beta * log(y_{it-1}) + u_{it} \tag{14}$$

For conditional β- convergence:

$$log(y_{it}/y_{it-1}) = \alpha + \beta * log(y_{it-1}) + \gamma * log(z_{it-1}) + \epsilon_{it} \tag{15}$$

where:

i = individual or entities, here the economies of the CMA/the provinces of the RSA,

t = particular year,

y_{it} = per capita income of ith individual or entities, for period t,

y_{it-1} = per capita income of ith individual or entities of the previous period,

z_{it-1} = the vector of conditional variables (both endowment and policy variables) of ith individual or entities of the previous year,

α = the intercept term, assumed to be constant,

u_{it} and ϵ_{it} are the error terms with mean zero, constant variances (${\sigma^2}_u$ and ${\sigma^2}_\epsilon$), and independent of t and i.

Similarly, σ-convergence is empirically modelled in the following way:

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[4] See Barro and Sala-i-Martin (1992, 1995).

[5] The solution can be achieved from the first-order difference equation.

$$\sigma_t = \pi + \gamma t + v_t \tag{16}$$

where σ is a measure of inequality, π[6] and γ are the coefficients, t is time, and v is the random error term. A negative value of γ implies declining inequality over time (σ-convergence), while a positive value of γ implies σ-divergence. To gain an understanding of inequality and σ-convergence in the CMA region and in the provinces of the RSA, the present study has calculated and analysed inequality with respect to per capita income in the economies of the CMA and the provinces of the RSA. Inequality[7] among the economies of the CMA and provinces of the RSA is measured by the standard deviation of the logarithm (SDL), Gini coefficient (GC), Kakwani index (KI), Mehran measure (MM), Piesch measure (PM) and Theil index (TI).[8]

4 Description of variables and data sources

For empirical analysis of the convergence hypothesis for the cross-section of four economies of the CMA and nine provinces of the RSA, Equations 14 to 16 are estimated for the periods 2000/01 to 2018/19 and 1998/99 to 2017/18. A couple of issues related to the data need to be discussed here.

For the country-level analysis of the CMA, the GDP of the primary sector (PGDP) is constructed using the series on 'Agriculture, Forestry and Fishing, Value Added (% of GDP)', extracted from the World Development Indicators (WDI 2020a). The GDP of the secondary sector (SGDP) is reached by adding two series, 'Industry (including Construction), Value Added (% of GDP)' and 'Manufacturing, Value Added (% of GDP)', extracted from WDI (2020j) and WDI (2020k) respectively. As the above-mentioned series are recorded in terms of percentage of GDP, the actual value of GDP for the primary and secondary sectors are arrived at by multiplying the sector share in terms of percentage by aggregate GDP. The GDP of the tertiary sector (TGDP) is calculated as a residual by taking the difference between aggregate GDP values and the combined value of PGDP and SGDP.

Further, in the raw dataset, the series on gross domestic savings (GDS) as a percentage of GDP series was unavailable for Lesotho for the period 2000–06. Similarly, the Consumer Price Index (CPI) figures for Namibia were unavailable for the years 2000 and 2001. These data gaps have been filled by adopting the three-year moving-average method. Though tax revenue as a percentage of GDP is one of the important variables in this study, the study could not consider it for analysis due to the unavailability of data for Eswatini during the entire study period.

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[6] This is also the level of inequality independent of time. Thus, if we assume that t and v include all of the explanation for inequality, then π may be viewed as the inevitable level of inequality.

[7] Inequality is multidimensional and multifaceted (Conceição and Bandura 2008) and the measures of inequality are a tricky issue anywhere (Sen 1997, 2002), let alone in the RSA, due to the multidimensional nature of the concept. The complexity and acceptability of a measure of inequality in the RSA is also discussed by Kerr and Wittenberg (2019a, b) and Merrino (2020). Merrino (2020) discusses the importance of Gini coefficient, dispersion ratios, and the generalised entropy index in measuring inequality. Detailed discussion on the inequality measures used here can be found in Fellman (2018), Idrees and Ahmad (2017), and Ray (2012). This paper considers issues related to economic inequality across regions.

[8] Many of these measures follow the Pigou-Dalton principles (Bosmans et al. 2009). For Dalton's principles of an inequality measure see Dalton (1920).

With respect to the nine provinces of the RSA, the present study has analysed annual data on GDP and other macroeconomic variables for the period 1998–2017. The data on the GDP of the provinces for the period of 1995–2017 are obtained from Statistics South Africa (SSA), and data on the fiscal variables of the provinces are obtained from the National Treasury of the RSA (NTRSA).[9] The online data on fiscal variables available from the NTRSA were limited to the period 1998 and thereafter. This study considers three sectors for each provincial economy of the RSA, i.e., primary, secondary, and tertiary sectors. The primary sector consists of agriculture, forestry and fishing, and mining and quarrying; the secondary sector consists of manufacturing, electricity, gas and water, and construction; and the tertiary sector consists of trade, catering and accommodation, transport, storage and communication, finance, real estate and business services, personal services, and general government services. The sectoral-level data for the provinces are available up to 2017. Therefore, analysis at the provincial level is carried out using data for the period 1998–2017, i.e. 20 years. Similarly, the analysis for the CMA is done for 19 years of annual data.[10] The choice of separate time periods for the economies of the CMA and the provinces of the RSA is largely guided by the availability of data. However, it does not invalidate the exercise, as both time periods cover the major economic challenges that the globe and the regions have recently faced.

The mid-year population data extracted from SSA are used for the calculation of per capita GDP. There were some missing values for some fiscal variables (such as transfers received, tax receipt, sales of goods and services other than capital assets, interest, dividends, and rent on land, salaries and wages, social contributions, transfers and subsidies, land and sub-soil assets, and software and other intangible assets) of the provinces. These missing values are proxied by interpolation and/or extrapolation (wherever necessary) of data using the moving-average technique. Further, those series with negative figures are made positive[11] by changing the origin of the series with the addition of a suitable constant positive number throughout the series. The relevant variables used for analysis are described in Table 1, while Table 2 describes the sources and construction of data for CMA.

[9] Data are sourced as follows: GDP by provinces, SSA (2020b); mid-year population, SSA (2020c); fiscal policy variables, provincial budget, National Treasury (2020); Consumer Price Index, SSA (2020a).

[10] The period of 20 years may be viewed as too small to study convergence. However, there are quite a number of studies in the literature that have considered a similar time period. To cite a few, Vojinovic et al. (2010): 1992–2006 (15 years), ten EU countries; Cavenaile and Dubois (2011): 1990–2007 (18 years), 27 EU countries; Yang et al. (2016): 1997–2006 (10 years), 31 provinces of China; Gömleksiz et al. (2017): 2004–14 (11 years), 26 Nomenclature of Territorial Units (NUTS) in two regions of Turkey; Comunale et al. (2019): 1997Q2–2018Q4 (22 years), Lithuania; Gezici and Hewings (2004): 1980–97 (18 years), 16 Functional Regions and 67 provinces of Turkey; Yildirim et al. (2009): 1987–2001 (15 years), 67 provinces of Turkey; Onder et al. (2010): 1980–2001 (22 years), 26 NUTS in two regions of Turkey; Kumo (2011): 1992–2009 (18 years), 15 countries in the SADC; Ringeta (2017): 1995–2013 (19 years), nine provinces of South Africa; Svetikas and Dzemyda (2009): 1995–2006 (12 years), regions of Lithuania; Tsionas (2000): 1977–96 (20 years), US regions; Sachs et al. (2002): 1980–98 (19 years), 14 Indian states; Ingianni and Žd'árek (2009): 1995–2006 (12 years), eight EU countries; Rapacki and Próchniak (2009): 1990–2005 (16 years), 27 transition (socialist) countries of East-Central Europe and the Commonwealth of Independent States (CIS); Sikic (2013): 1997–2012 (16 years), ten new member states of the EU; Simionescu (2014): 2000–12 (13 years), 28 EU countries; Pandya and Maind (2017): 1990/91–2010/11 (21 years), 27 states and Union Territories of India; Ram (2020): 1997–2018 (22 years), 48 contiguous US states; Matkowski and Próchniak (2004): 1993–2004 (12 years), eight EU countries.

[11] Since the estimation of Equations 14 and 15 requires the logarithm of the values, all the values should be positive.

Table 1: Variable descriptions for test of convergence in CMA and RSA

$PCGDP_{t-1}$	Per capita GDP at constant price
$PCPGDP_{t-1}$	Per capita GDP of Primary Sector at constant price
$PCSGDP_{t-1}$	Per capita GDP of Secondary Sector at constant price
$PCTGDP_{t-1}$	Per capita GDP of Tertiary Sector at constant price
λGDPPC	Logarithm of the ratio of per capita GDP at time t to per capita GDP at time $t-1$ $\left(\frac{GDPPC_t}{GDPPC_{t-1}}\right)$
λPCPGDP	Logarithm of the ratio of per capita primary sector GDP at time t to per capita primary sector GDP at time $t-1$ $\left(\frac{PCPGDP_t}{PCPGDP_{t-1}}\right)$
λPCSGDP	Logarithm of the ratio of per capita secondary sector GDP at time t to per capita secondary sector GDP at time $t-1$ $\left(\frac{PCSGDP_t}{PCSGDP_{t-1}}\right)$
λPCTGDP	Logarithm of the ratio of per capita tertiary sector GDP at time period t to per capita tertiary sector GDP at time $t-1$ $\left(\frac{PCTGDP_t}{PCTGDP_{t-1}}\right)$
EXP_{t-1}	Exports
IMP_{t-1}	Imports
$EXCH_{t-1}$	Bilateral exchange rate with US$
$BRMO_{t-1}$	Broad money as % of GDP
$DEBT_{t-1}$	Debt as % of GDP
$GFCE_{t-1}$	Government final consumption expenditure
GDS_{t-1}	GDS as % of GDP
$REIR_{t-1}$	Real interest rate
$NARR_{t-1}$	Natural resources rent as % of GDP
CPI_{t-1}	Consumer Price Index
TAX_{t-1}	Per capita tax receipts
$SGSOCA_{t-1}$	Per capita revenue from sales of goods and services other than capital assets
TR_{t-1}	Per capita transfer received
$IDRL_{t-1}$	Per capita revenue from interest, dividends, and rent on land
EDU_{t-1}	Per capita expenditure on education
$HEALTH_{t-1}$	Per capita expenditure on health
$SOCDEV_{t-1}$	Per capita expenditure on social development
$TRANS_{t-1}$	Per capita expenditure on transportation infrastructure
SW_{t-1}	Per capita expenditure on salaries and wages
TS_{t-1}	Per capita expenditure on transfers and subsidies
$LSSA_{t-1}$	Per capita expenditure on Land and sub-soil assets
$SOIA_{t-1}$	Per capita expenditure on software and other intangible assets

Note: values of all the variables are in logarithm; subscript t indicates time.

Source: authors' construction based on literature review (Section 2).

Table 2: Data sources and variable construction for the CMA

Variables	Source and construction
GDP	WDI (2020e)
PCGDP	Per capita GDP, constructed using GDP and population data from WDI (2020m)
PGDP	GDP of primary sector, constructed from WDI (2020a)
SGDP	GDP of secondary sector, constructed by adding the 'Industry (including Construction), Value Added (% of GDP)' and 'Manufacturing, Value Added (% of GDP)' series, WDI (2020j) and WDI (2020k) respectively
TGDP	GDP of tertiary sector, constructed as a residual by subtracting the percentage contribution of PGDP and percentage contribution of SGDP from 100%: 100% − (% of PGDP + % of SGDP) = TGDP
PCPGDP	Per capita primary sector GDP, constructed by dividing PGDP by population
PCSGDP	Per capita secondary sector GDP, constructed by dividing SGDP by population
PCTGDP	Per capita tertiary sector GDP, constructed by dividing TGDP by population
DEBT	Global debt database; IMF (2020)
GFCE	Government final consumption expenditure (% of GDP), from WDI (2020g)
CPI	Consumer Price Index (2010 = 100), from WDI (2020c)
EXP	Exports of goods and services (constant local currency units/LCU), from WDI (2020d)
IMP	Imports of goods and services (constant LCU), from WDI (2020i)
NARR	Total natural resources rents (% of GDP), from WDI (2020o)
REIR	Real interest rate (%), from WDI (2020n)
BRMO	Broad money (% of GDP), from WDI (2020b)
GDS	Gross domestic savings (% of GDP), from WDI (2020h)
EXCH	Official exchange rate (LCU per US$, period average), from WDI (2020l)

Source: authors' construction based on literature review (Section 2).

Equations 14 to 16 are empirically estimated for the four countries of the CMA and the nine provinces of the RSA using the above-mentioned data and the statistical software STATA 13.0 edition (StataCorp 2013), and the results are discussed in the following section.

5 Empirical results and discussion

Before discussing the empirical results on the convergence hypothesis for the economies of the CMA and the provinces of the RSA, it is pertinent to have some idea about the economic performance of these regions.

5.1 Economic performance of the countries of the CMA and provinces of the RSA

Table 3 presents the annual average growth rate (AAGR) of per capita GDP in purchasing power parity (PPP) of some of the major economies of the world from 2001 to 2019. The table reveals that the performance of the leading economy of the CMA, i.e., the RSA, is lower than the world average for the entire period as well as subperiods. In fact, if we compare it with that of other major economies of the world, the AAGR of the RSA is higher than only two 'matured and advanced' economies (Japan, with AAGR at 0.570, and the USA, AAGR 0.823) in one subperiod (2001–10: the AAGR of the RSA in this period is 2.147). Brazil is the only sample economy with negative AAGR from 2011 to 2019 (however, for the entire period, Brazil's AAGR is higher than that of the RSA).

Table 3: AAGR of per capita GDP (PPP) of some important economies

Period	Brazil	India	China	Russia	**RSA**	Japan	USA	**World**
2001–10	2.543	5.104	9.929	5.207	**2.147**	**0.570**	**0.823**	**2.306**
2011–19	−0.134	5.351	6.844	1.339	**0.030**	1.120	1.553	**2.227**
2001–19	1.275	5.221	8.468	3.375	**1.144**	0.831	1.168	**2.269**

Note: GDP is at 2010 constant prices.

Source: authors' construction based on data from WDI (2020f).

Table 4 reveals that the RSA is the leading economic power in the CMA region in both aggregate and per capita terms. In terms of recent (since 2016–19) economic performance in the CMA, except Eswatini, all members have experienced a negative growth rate in per capita income. The recent COVID-19 pandemic may make the situation even worse in the region. Even the best performer in the region—Eswatini—had a meagre growth rate of 1.321 in 2018, a very low figure in comparison with the leading economies of the world (see Table 3). The AAGR of GDP, per capita GDP, sectoral GDP, and sectoral per capita GDP for the entire study period (2000–19) in the region also shows very dismal performance (see Table 5). Though the performance of the tertiary sector is reasonable (the AAGR of the sector is 3.37, 4.05, 4.62, and 7.62 for the RSA, Namibia, Lesotho, and Eswatini respectively, and the sector is performing better in per capita terms also), the performance of the primary and secondary sectors (except for Namibia, the AAGR of SGDP is 5.10) is a matter of concern. In fact, the negative AAGR of PCPGDP (−0.21) and very low AAGR of PCSGDP (0.10) in the RSA is an indication of growth-reducing structural change (policies to induce resource allocation from one sector to other) in the economy.

Table 4: Economic performance of the economies of the CMA

Indicator(s)	**Year**	**Eswatini**	**Lesotho**	**Namibia**	**RSA**
GDP (billion US$)	2016	5.194	2.950	14.485	420.213
	2017	5.300	2.911	14.447	426.157
	2018	5.424	2.898	14.548	429.511
	2019	5.533	2.942	14.383	430.167
GDP annual growth (%)	2016	1.268	5.047	−0.281	0.399
	2017	2.040	−1.322	−0.262	1.414
	2018	2.340	−0.446	0.699	0.787
	2019	2.009	1.518	−1.134	0.153
GDP (PPP) (billion US$)	2016	9.364	5.899	24.209	714.001
	2017	9.553	5.821	24.147	724.101
	2018	9.778	5.794	24.316	729.800
	2019	9.975	5.882	24.040	730.913
GDP (PPP) annual growth (%)	2016	1.268	5.047	−0.281	0.399
	2017	2.018	−1.322	−0.256	1.415
	2018	2.355	−0.464	0.700	0.787
	2019	2.015	1.519	−1.135	0.153
GDP per capita (PPP) (US$)	2016	8,405.799	2,842.699	10,266.746	12,703.820
	2017	8,493.902	2,783.116	10,050.501	12,703.421
	2018	8,606.076	2,748.544	9,931.973	12,630.747
	2019	8,688.101	2,767.714	9,637.181	12,481.813
GDP per capita (PPP) annual growth (%)	2016	0.365	4.238	−2.105	−1.061
	2017	1.048	−2.096	−2.106	−0.003
	2018	1.321	−1.242	−1.179	−0.572
	2019	0.953	0.697	−2.968	−1.179

Note: GDP is at 2010 constant prices.

Source: authors' construction based on data from WDI (2020f).

Table 5: AAGR of GDP and its components in the economies of the CMA

	RSA	Namibia	Lesotho	Eswatini
GDP and its components				
GDP at constant prices	2.69	4.04	3.22	3.11
PCGDP	1.27	2.26	3.02	2.41
PGDP	1.19	1.76	1.36	1.44
SGDP	1.51	5.10	3.60	2.16
TGDP	3.73	4.05	4.62	7.62
PCPGDP	−0.21	0.01	1.04	0.76
PCSGDP	0.10	3.31	3.37	1.47
PCTGDP	2.30	2.27	4.48	6.89

Note: GDP is at 2010 constant prices.

Source: authors' construction based on data from WDI (2020f).

The AAGR of some of the key macroeconomic indicators of the economies of the region is presented in Table 6. The table reveals that for Lesotho and Eswatini, the growth rate of the exports is greater than the growth rate of imports—*prima facie*, a sign of good health in the external sector in these two economies. The positive AAGR of broad money could be associated with the positive AAGR of the CPI of the region. However, the continuous growth of the CPI may be a hindrance to the international price advantages of the economies. The growth of the real interest rate may crowd out the domestic investment leading to low growth of the economy and encourage foreign capital inflow resulting balance of payment (BoP) crisis. In fact, the higher REIR has not been successful in promoting GDS in their respective economies.

Table 6: AAGR of macroeconomic indicators in the economies of the CMA

	RSA	Namibia	Lesotho	Eswatini
Macroeconomic indicators				
Exports	2.19	3.61	10.01	3.53
Imports	5.00	7.41	5.13	1.91
Broad money as % of GDP	1.89	2.67	2.45	3.10
Real interest rate	10.38	81.33	114.18	−1,659.67
Natural resources rent as % of GDP	7.27	18.89	5.11	4.43
Debt as % of GDP	2.00	6.49	−2.51	5.49
Government final consumption expenditure	3.37	3.96	7.51	5.87
CPI 2010	5.36	5.31	6.40	6.76
Gross domestic saving as % of GDP	0.45	0.57	0.33	0.02

Note: GDP is at 2010 constant prices.

Source: authors' construction based on data from WDI (2020f).

The AGR of some of the economic indicators of the region is presented in Figure 2. The figure reveals that in all four indicators, there has been growth with periodic fluctuations, representing the volatile nature of the economies. In fact, the significant drop in the real interest rate in Eswatini in 2012/13 is beyond any plausible economic logic explored in this study. The persistent high yet fluctuating debt–GDP ratio, inflation (measured by CPI), and low GDS indicate the poor macroeconomic performance of the region.

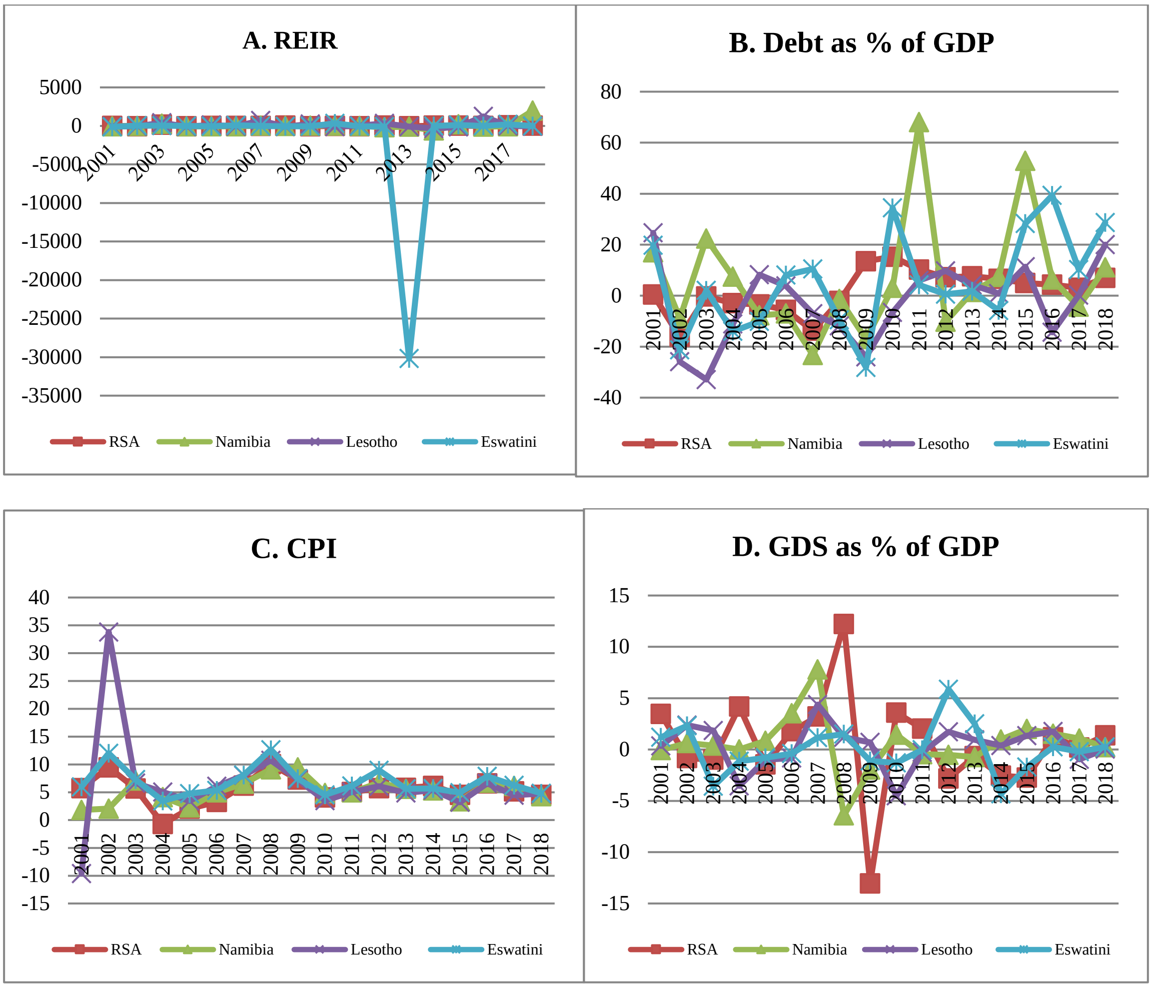
The economic performance and the AAGR of the various indicators of growth of the nine provinces of the RSA during the study period are presented in Table 7. The higher growth rate of GDP at current prices over GDP at constant prices in all nine provinces is an indication of the growth of price levels in all the provinces. The provinces containing the legislative and administrative capitals of RSA—namely, WC and GA[12]—have higher growth rates than other provinces (3.33 and 3.22 respectively). This highlights the agglomeration effect: the role of policies and institutions and of proximity to them in determining economic performance. Sector-wise performance in the region shows that in both per capita and absolute terms, the performance of the tertiary sector is better than that of the primary and secondary sectors. In fact, in per capita terms, except in three provinces (namely, EC, KN, and LI), AAGR is negative in the primary sector. In the secondary sector, WC, NC, and GA have negative growth in per capita terms.

The AAGR of other economic indicators and policy variables of the provinces of the RSA is presented in Table 8. Perusal of the table reveals that there are wide disparities in the performance

[12] The legislative capital Cape Town is in Western Cape and the administrative capital Pretoria is in Gauteng.

of the provinces with respect to macroeconomic indicators and policy variables. The performance of provinces such as GA, LI, and WC is better than the performance of the provinces such as FS and NC, indicating inequalities (differences in economic performance) across provinces.

Figure 2: AGR of some economic indicators of the CMA



Note: GDP is at 2010 constant prices.

Source: authors' illustration based on data from WDI (2020f).

Table 7: AAGR of GDP and its components in the nine provinces of the RSA

	Provinces								
	WC	EC	NC	FS	KN	NW	GA	MP	LI
GDP at current price	9.87	9.68	10.06	9.54	9.81	10.17	10.10	10.47	10.98
GDP at constant price	3.33	2.48	1.81	1.99	2.96	1.45	3.22	2.16	2.30
PCGDP at current price	7.29	9.79	8.16	9.27	8.48	9.71	6.64	8.08	10.37
PCGDP at constant price	0.89	2.59	0.11	1.76	1.71	1.03	−0.03	−0.04	1.75
PGDP	2.29	1.82	0.89	0.29	1.29	−0.08	−1.70	1.13	1.64
SGDP	2.35	2.67	1.11	2.05	2.42	2.02	2.47	2.36	2.60
TGDP	3.87	2.52	2.75	2.60	3.55	2.75	3.93	2.91	2.77
PCPGDP	-0.20	2.03	−0.77	0.06	0.07	−0.46	−4.78	−1.04	1.06
PCSGDP	−0.04	2.76	−0.61	1.79	1.20	1.61	-0.76	0.17	2.06
PCTGDP	1.42	2.62	1.04	2.36	2.28	2.30	0.65	0.69	2.23

Source: authors' construction based on data from SSA (2020b, c).

The higher AAGR of the per capita capital expenditure in EC (22.55 per cent) and on transport infrastructure (34.72 per cent) justifies the highest AAGR of the provinces in per capita GDP at current price (2.59 per cent). NW has the highest AAGR in almost all economic indicators: the AAGR of per capita social expenditure is as high as 94.22 per cent for this province. The per capita expenditure in education and health grows almost at the same rate in all provinces except NW (where the AAGR of expenditure on education and health is 14.47 per cent and 55.16 per cent). The AAGR of the transfer received is highest for WC (38.50 per cent), the province where the legislative capital is located (an example of the role of institutions in policy decisions).

Table 8: AAGR of economic indicators in the provinces of the RSA

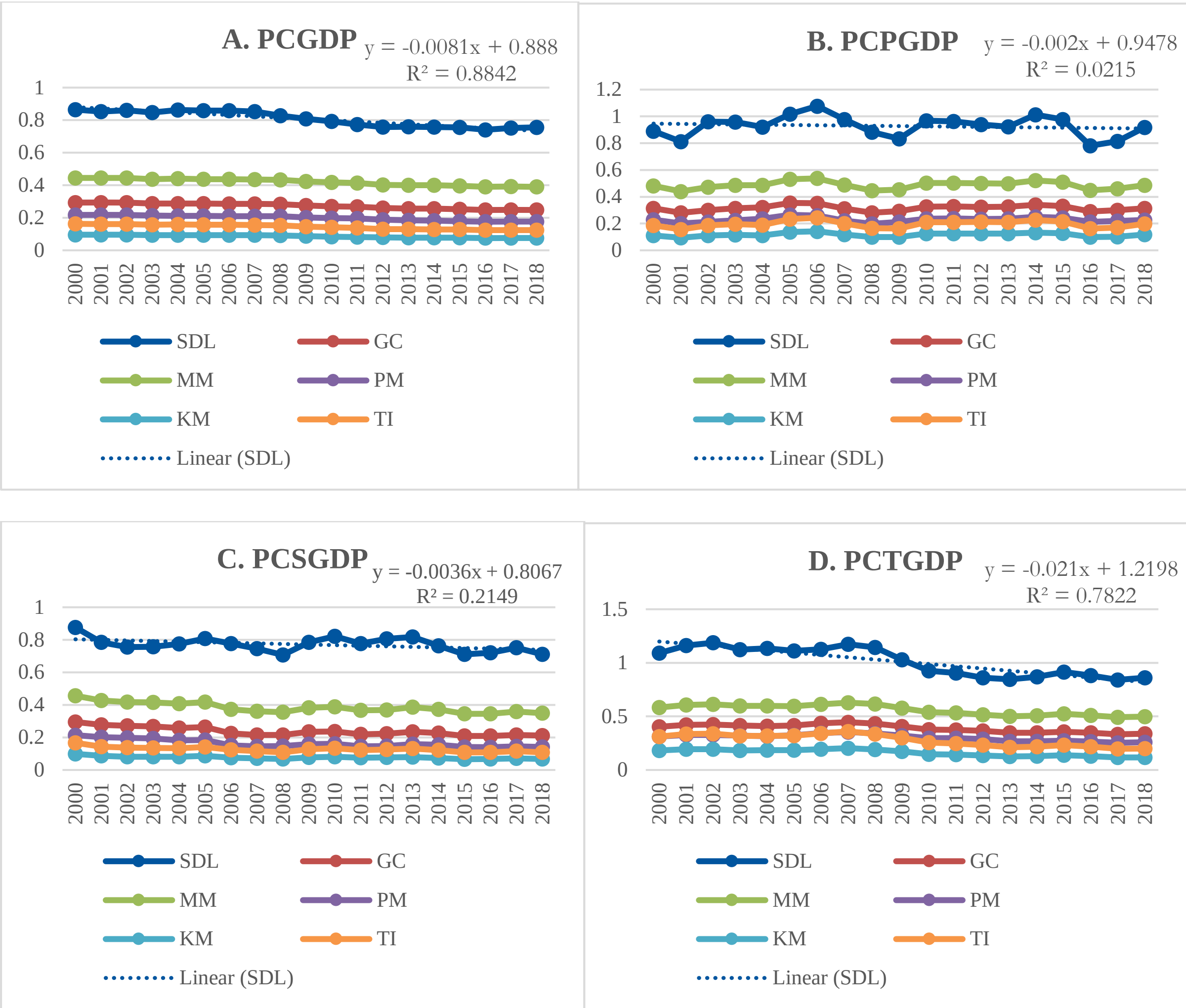
	Provinces								
	WC	EC	NC	FS	KN	NW	GA	MP	LI
TAX	6.32	15.13	6.81	9.03	7.62	11.04	6.34	18.53	9.49
SGSOCA	5.76	7.34	6.83	4.43	4.44	10.55	3.34	7.75	4.18
TR	38.50	7.53	31.84	5.43	14.87	2.32	7.69	8.76	6.94
EDU	6.93	8.78	9.12	8.59	9.56	14.47	7.62	9.05	8.49
HEALTH	8.59	11.14	12.91	9.71	10.64	55.16	7.99	11.55	12.09
SOCDEV	2.90	8.00	6.98	8.16	6.32	94.22	5.74	7.49	13.60
TRANS	10.67	34.72	7.36	10.03	16.63	11.15	13.27	12.30	21.83
SW	7.07	7.00	8.57	6.49	7.63	7.12	6.02	14.79	8.07
TS	4.63	5.37	5.59	5.40	9.05	22.74	7.86	8.81	9.97
SOIA	12.85	62.05	66.70	46.53	33.59	27.63	10.57	14.02	28.50
Per capita total provincial own receipts	8.23	12.50	6.97	7.86	11.04	9.36	7.72	50.07	10.85
Per capita interest, dividends, and rent on land	3.94	35.49	6.86	2.70	36.91	20.14	16.18	8.42	23.13
Per capita capital expenditure	8.88	22.55	14.44	10.59	9.57	13.33	5.73	11.13	6.39
Per capita expenditure on financial assets	11.42	7.53	8.33	6.67	561.93	9.02	5.37	2.58	6.87
Per capita buildings and other fixed structures	10.85	33.11	15.72	27.49	11.52	16.18	8.58	11.09	12.81
Per capita expenditure on economic development, environmental affairs, and tourism	7.56	17.70	23.39	14.05	28.73	32.88	17.68	25.52	11.84

Source: authors' construction based on data from National Treasury (2020).

5.2 Inequality among the economies of the CMA and the provinces of the RSA

The trend in various measures of inequality between the regions (members of CMA) are presented in Figure 3. Further, a trend line is fitted to one of the measures of inequality, i.e. the SDL, to show the trend of inequality at both aggregate and sectoral level. Figure 3 reveals that at the aggregate level, inequality has declined over the period (part A), though with respect to the primary sector, there have been some periodic fluctuations in inequality in the region. Inequality in the secondary sector has also fluctuated. The tertiary sector has witnessed the highest decline in inequality. However, the overall trend of inequality in the region is downward—a sign of σ-convergence.

Figure 3: Trend of inequality among the economies of CMA

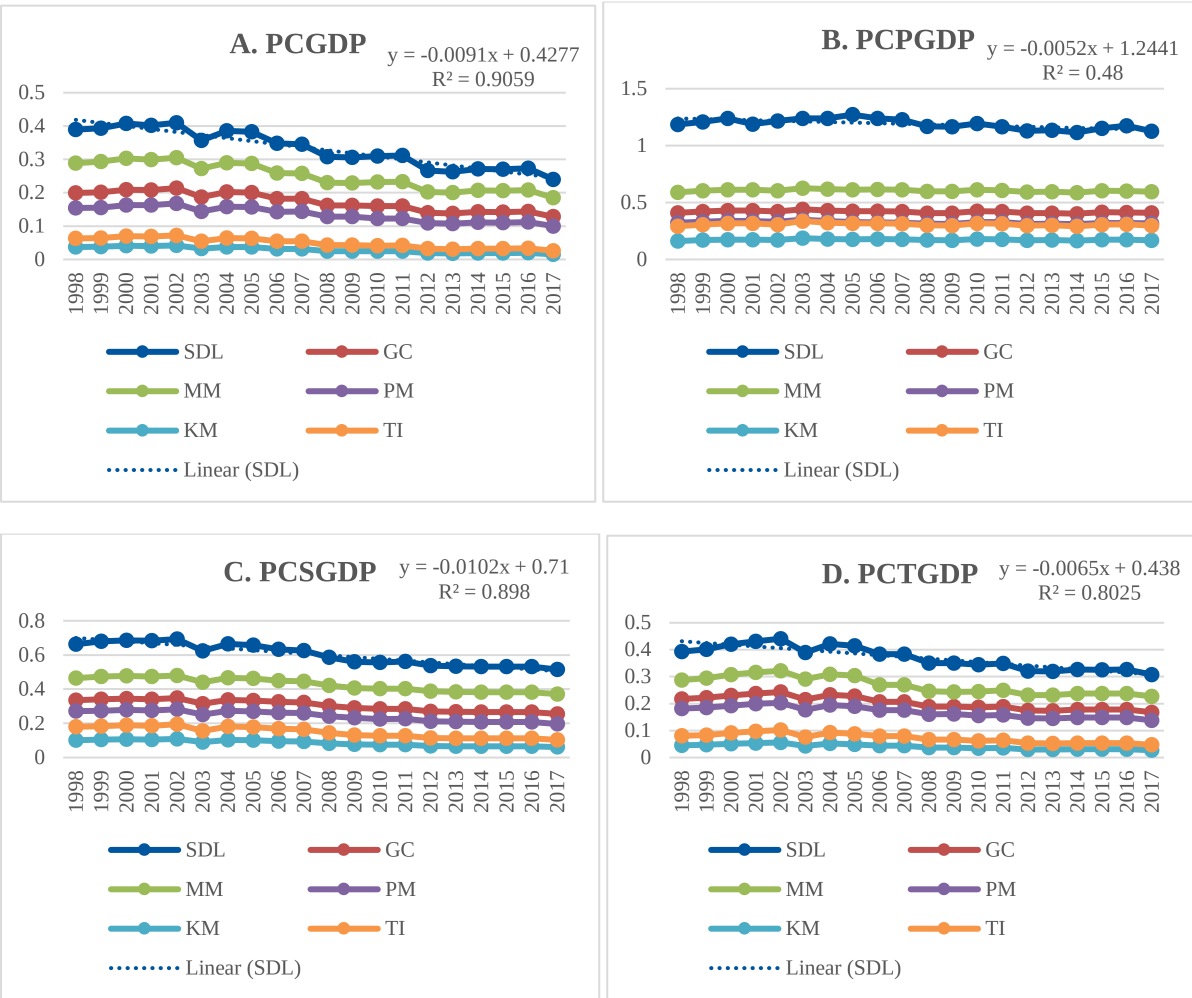


Note: GDP is at 2010 constant prices.

Source: authors' illustration based on data from WDI (2020f).

Figure 4 reveals the pattern of inequality among the provinces of the RSA since 1998; it shows that all six measures of inequality display a declining trend both for the aggregate economy and in the sectors. However, the decline in inequality is greater in the secondary and tertiary sectors than in the primary sector (parts B, C, and D).

Figure 4: Trend of inequality among the provinces of the RSA



Source: authors' illustration based on data from SSA (2020b, c).

5.3 Convergence in the economies of the CMA and in the provinces of the RSA

The growth ratios of PCGDP, PCPGDP, PCSGDP, and PCTGDP for the economies of the CMA and the provinces of the RSA are used to explore the presence/absence of absolute β-convergence. For the CMA, the four countries are ranked into two broad groups, 'Rich' and 'Poor', on the basis of the income level in the initial year (2000) for each component of GDP. The 'Rich' and 'Poor' groups categorize the top two and bottom two countries in terms of this measure in 2000. The mean values of the AGR of the measures are estimated for both the 'Rich' and the 'Poor' groups. Now, the ratio of 'mean value of the AAGR of Poor' to 'mean value of the AAGR of Rich' will suggest the possibility of absolute β-convergence/divergence. If the value of the ratio is greater than 1, we can conclude that there is absolute β-convergence, suggesting that initially poor countries grew faster than their richer counterparts during the study period. Similarly, the provinces of the RSA are ranked as 'top four poor' and 'top four rich', and 'top five poor' and 'top five rich', based on their per capita GDP and sector-wise per capita GDP in the initial year, i.e. 1998. The calculated growth ratios are presented in Table 9, which reveals, *prima facie*, the presence of absolute β-convergence among both the economies of the CMA and the provinces of the RSA.

Table 9: Ratio of the AAGR of the CMA and the RSA

Countries of CMA (base year: 2000)			
Variables		Ratio for group of two countries	Conclusion
PCGDP		1.53	absolute β-convergence
PCPGDP		1.08	absolute β-convergence
PCSGDP		4.23	absolute β-convergence
PCTGDP		2.48	absolute β-convergence
Provinces of RSA (base year: 1998)			
	Ratio for group of four provinces	Ratio for group of five provinces	
PCGDP	7.555	3.281	absolute β-convergence
PCPGDP	2.379	2.453	absolute β-convergence
PCSGDP	10.228	3.221	absolute β-convergence
PCTGDP	1.726	1.645	absolute β-convergence

Note: GDP is at 2010 constant prices.

Source: authors' construction based on data from SSA (2020a, b, c); WDI (2020a, j, k, l).

Additionally, Equations 14 and 15 are estimated using the data for the countries of the CMA and provinces of the RSA to empirically test the presence/absence of absolute and conditional β-convergence in the regions. Since this estimation is done with a balanced set of panel data, before undertaking the estimation of data, it is important to test for the poolability of the data. The results of the poolability test, the Hausman test (to choose between fixed effect/FE or random effect/RE models) and other diagnostic tests are presented in Tables 10 and 11. The results of all poolability tests show that the data are not poolable. Therefore, in addition to the FE and RE models, simple pooled regression (cross-section and time series regression) technique with correction for group-wise and within-group heteroscedasticity and between-group auto-correlation correction has been done. The two techniques in the panel regression analysis that correct for heteroscedasticity and autocorrelation are the feasible generalized least squares (FGLS) and panel-corrected standard error (PCSE) methods. Thus, the FGLS and PCSE models are also estimated. The significant F and $\chi 2$ values for all models indicate the acceptability and reliability of the models. The estimated result of Equation 14 for the CMA is presented in Table 10.

Table 10: Empirical results of Equation 14 for the CMA

Dependent variable: λPCGDP		Poolability test		Hausman test
		F (3, 67) = 3.87, Prob > F = 0.012		χ2= 10.51, Prob > χ2 = 0.001
Variables/model	**FE**	**RE**	**FGLS**	**PCSE**
Constant	0.246* (.063)	0.045* (0.014)	0.045* (0.013)	0.047** (0.023)
$PCGDP_{t-1}$	−0.066* (0.017)	−0.010* (0.003)	−0.010* (0.003)	−0.010*** (0.006)
	R^2 = 0.086 F = 13.92 Prob > F = 0.000	R^2 = 0.086 Wald χ^2 = 6.59 Prob > χ^2 = 0.010	Wald χ^2 = 6.78 Prob > χ^2 = 0.009	R^2 = 0.037 Wald χ^2 = 2.71 Prob > χ^2 = 0.099
Dependent variable: λPCPGDP		Poolability test		Hausman test
		F (3, 67) = 10.19, Prob > F = 0.000		χ2 = 30.67, Prob > χ2 = 0.000
Variables/model	**FE**	**RE**	**FGLS**	**PCSE**
Constant	1.466* (0.264)	0.016 (0.037)	0.016 (0.003)	0.012 (0.052)
$PCPGDP_{t-1}$	−0.632* (0.114)	−0.007 (0.016)	−0.007 (0.015)	−0.005 (0.021)
	R^2 = 0.003 F = 30.77 Prob > F = 0.000	R^2 = 0.003 Wald χ^2 = 0.21 Prob > χ^2 = 0.648	Wald χ^2 = 0.21 Prob > χ^2 = 0.643	R^2 = 0.001 Wald χ^2 = 0.07 Prob > χ^2 = 0.795

Dependent variable: λPCSGDP		Poolability test		Hausman test
		F (3, 67) = 7.07, Prob > F = 0.000		$\chi 2$ = 19.85, Prob > $\chi 2$ = 0.000
Variables/model	**FE**	**RE**	**FGLS**	**PCSE**
Constant	0.838* (0.175)	0.074** (0.038)	0.074** (0.037)	0.099*** (0.058)
$PCSGDP_{t-1}$	−0.256* (0.054)	−0.020*** (0.011)	−0.020*** (0.011)	−0.028*** (0.016)
	R^2 = 0.042 F = 22.37 Prob > F = 0.000	R^2 = 0.042 Wald χ^2 = 3.08 Prob > χ^2 = 0.079	Wald χ^2 = 3.17 Prob > χ^2 = 0.074	R^2 = 0.052 Wald χ^2 = 2.83 Prob > χ^2 = 0.092
Dependent variable: λPCTGDP		Poolability test		Hausman test
		F (3, 67) = 0.65, Prob > F = 0.585		$\chi 2$ = 0.33, Prob > $\chi 2$ = 0.563
Variables/model	**FE**	**RE**	**FGLS**	**PCSE**
Constant	0.123 (0.110)	0.063*** (0.033)	0.063** (0.033)	0.077 (0.051)
$PCTGDP_{t-1}$	−0.034* (0.015)	−0.015 (0.010)	−0.015 (0.010)	−0.019 (0.015)
	R^2 = 0.028 F = 0.97 Prob > F = 0.328	R^2 = 0.028 Wald χ^2 = 2.02 Prob>χ^2 = 0.155	Wald χ^2 = 2.07 Prob>χ^2 = 0.149	R^2 = 0.028 Wald χ^2 = 1.72 Prob>χ^2 = 0.189

Note: *, **, and *** represent significance at 1%, 5%, and 10% respectively; figures in parentheses are respective standard errors; GDP is at 2010 constant prices.

Source: authors' construction based on data from WDI (2020f).

The empirical results for the test of absolute β-convergence in the CMA show that the coefficient(s) of the explanatory variable are negative and less than 1 for the aggregate economy and secondary sector in all models (for the aggregate economy the coefficients are −0.066, −0.010, −0.010, and −0.01, and for the secondary sector the coefficients are −0.256, −0.020, −0.020, and −0.028, in the FE, RE, FGLS, and PCSE models respectively). This implies that in the CMA region, the growth rates of aggregate per capita GDP and GDP from the secondary sector of the poorer economies, Lesotho and Eswatini, are greater than those of their richer counterparts. Similar results are also obtained for the growth rate of the secondary sector. Though conclusive remarks cannot be made on the primary and tertiary sectors (since the coefficients are not significant except in the FE model), the negative value of the coefficients is indicative of the presence of absolute β-convergence. This implies that the growth rates of the initially poorer economies in the region are greater than those of their richer counterparts (this is endorsed by Tables 4 and 5).

Table 11: Empirical results of Equation 14 for the RSA

Dependent variable: λPCGDP		Poolability test F (8,161) = 1.02, Prob > F = 0.421		Hausman test χ^2 = 5.91, Prob > χ^2 = 0.015
Variables/model	**FE**	**RE**	**FGLS**	**PCSE**
Constant	1.109* (0.330)	0.349* (0.104)	0.349* (0.103)	0.326** (0.135)
$PCGDP_{t-1}$	−0.102* (0.031)	−0.031* (0.010)	−0.031* (0.010)	−0.029** (0.012)
	R^2 = 0.060 F-test = 11.13 Prob > F = 0.001	R^2 = 0.060 Wald χ^2 = 10.71 Prob> χ^2 = 0.001	Wald χ^2 = 10.83 Prob > χ^2 = 0.001	R^2 = 0.061 Wald χ^2 = 5.59 Prob> χ^2 = 0.018
Dependent variable: λPCPGDP		Poolability test F (8,161) = 3.11, Prob > F = 0.002		Hausman test χ^2 = 14.41, Prob > χ^2 = 0.000
Variables/model	**FE**	**RE**	**FGLS**	**PCSE**

Constant	1.350* (0.348)	0.043 (0.052)	0.034 (0.044)	0.035 (0.046)
$PCPGDP_{t-1}$	−0.157* (0.040)	−0.006 (0.006)	−0.005 (0.005)	−0.005 (0.005)
	R^2 = 0.0053 F-test = 15.20 Prob > F = 0.000	R^2 = 0.0053 Wald χ^2 = 0.93 Prob > χ^2 = 0.335	Wald χ^2 = 0.92 Prob > χ^2 = 0.337	R^2 = 0.0089 Wald χ^2 = 0.94 Prob > χ^2 = 0.331
Dependent variable: λPCSGDP		Poolability test		Hausman test
		F (8, 161) = 2.10, Prob > F = 0.038		χ^2 = 10.63, Prob > χ^2 = 0.000
Variables/model	**FE**	**RE**	**FGLS**	**PCSE**
Constant	1.060* (0.283)	0.160* (0.060)	0.160* (0.060)	0.128*** (0.073)
$PCSGDP_{t-1}$	−0.118* (0.032)	−0.017** (0.007)	−0.017* (0.007)	−0.014*** (0.008)
	R^2 = 0.0364 F-test = 13.86 Prob > F = 0.000	R^2 = 0.0364 Wald χ^2 = 6.39 Prob > χ^2 = 0.011	Wald χ^2 = 6.46 Prob > χ^2 = 0.011	R^2 = 0.0194 Wald χ^2 = 2.73 Prob > χ^2 = 0.098
Dependent variable: λPCTGDP		Poolability test		Hausman test
		F (8, 161) = 1.34, Prob > F = 0.225		χ^2 = 7.09, Prob > χ^2 = 0.007
Variables/model	**FE**	**RE**	**FGLS**	**PCSE**
Constant	0.809* (0.232)	0.231* (0.083)	0.231* (0.083)	0.216*** (0.112)
$PCTGDP_{t-1}$	−0.078* (0.023)	−0.021* (0.008)	−0.021* (0.008)	−0.020*** (0.011)
	R^2 = 0.0378 F-test = 11.62 Prob > F = 0.000	R^2 = 0.0378 Wald χ^2 = 6.65 Prob > χ^2 = 0.009	Wald χ^2 = 6.73 Prob > χ^2 = 0.009	R^2 = 0.0304 Wald χ^2 = 3.29 Prob > χ^2 = 0.069

Note: *, **, and *** represent significance at 1%, 5%, and 10% respectively; figures in parentheses are respective standard errors.

Source: authors' construction based on data from SSA (2020b, c).

The results of the test for absolute β-convergence in the provinces of the RSA are presented in Table 11. The table shows that the coefficients of the independent variable are negative and significant for all the models for aggregate GDP, and for GDP from the secondary and tertiary sectors (the coefficients are −0.102, −0.031, and −0.31, −0.029; −0.118, −0.017, −0.017, and −0.014; and −0.078, −0.021, −0.021, and −0.020 for PCGDP, PCSGDP, and PCTGDP in the FE, RE, FGLS, and PCSE models respectively). On the other hand, even if the coefficient is significant only in the FE model (the value is −0.157), the negative value of the coefficients for the primary sector indicates the presence of absolute β-convergence among the provinces of the RSA, a result arrived at, *prima facie*, from the growth ratios (Table 9).

As discussed in the literature and the analytical framework, the growth performance of various economies may be conditional upon their initial endowment, economic fundamentals, institutions, and policies (conditional β-convergence). This concept is empirically tested for the CMA and the RSA by Estimating Equation 15, and the results are presented in Tables 12 to 15 and Tables 16 to Table 19 respectively.

Table 12 reveals that the FGLS and PCSE models predict conditional β-convergence with respect to aggregate GDP in the CMA (the coefficients are −0.026 and −0.028, respectively). The result reveals that the bilateral exchange rate has a positive impact whereas the initial natural endowment (as represented by natural resources rent as a percentage of GDP, NARR) and government final consumption expenditure have negative impact on the growth of PCGDP in these economies. This shows that economies with a lower level of initial resource endowment have a higher growth rate in the region.

Table 12: Empirical results of Equation 15 for PCGDP in the CMA

Dependent variable: λPCGDP		Poolability test	Hausman test	
		F (3, 57) = 0.32, Prob > F = 0.814	χ2 = 0.94, Prob > χ2 = 0.990	
Variables/model	**FE**	**RE**	**FGLS**	**PCSE**
Constant	0.199 (0.277)	0.012 (0.045)	0.012 (0.041)	0.004 (0.051)
$PCGDP_{t-1}$	−0.018 (0.081)	−0.026 (0.017)	−0.026*** (0.015)	−0.028*** (0.016)
EXP_{t-1}	0.022 (0.023)	0.022 (0.021)	0.022 (0.019)	0.022 (0.019)
IMP_{t-1}	0.024 (0.020)	0.022 (0.020)	0.022 (0.018)	0.027 (0.020)
$EXCH_{t-1}$	−0.039** (0.016)	−0.040* (0.015)	0.040* (0.014)	0.038** (0.016)
$BRMO_{t-1}$	0.017 (0.028)	0.005 (0.016)	0.005 (0.014)	0.006 (0.017)
$DEBT_{t-1}$	−0.013 (0.013)	−0.011 (0.010)	−0.011 (0.009)	−0.013 (0.012)
$GFCE_{t-1}$	−0.064 (0.054)	−0.034** (0.019)	−0.034* (0.017)	−0.037* (0.017)
GDS_{t-1}	−0.004 (0.009)	−0.006 (0.008)	−0.006 (0.007)	−0.007 (0.007)
$REIR_{t-1}$	0.008 (0.007)	0.007 (0.006)	0.007 (0.007)	0.007 (0.005)
$NARR_{t-1}$	−0.022* (0.009)	−0.020* (0.006)	−0.020* (0.006)	−0.021* (0.007)
CPI_{t-1}	0.035 (0.037)	0.018 (0.018)	0.018 (0.016)	0.020 (0.018)
	R^2 = 0.171 F = 4.23 Prob > F = 0.000	R^2 = 0.473 Wald χ^2 = 53.94 Prob > χ^2 = 0.000	Wald χ^2 = 64.72 Prob > χ^2 = 0.000	R^2 = 0.475 Wald χ^2 = 66.65 Prob>χ^2 = 0.000

Note: *, **, and *** represent significance at 1%, 5%, and 10% respectively; figures in parentheses are respective standard errors; GDP is at 2010 constant prices.

Source: authors' construction based on data from WDI (2020f).

Similarly, for the primary sector, if we control for other economic variables, the region exhibits conditional β-convergence (the coefficients are −0.781, −0.131, −0.131, and −0.112 for the FE, RE, FGLS, and PCSE models respectively; Table 13). The variables that affect the per capita growth in primary sector are GDS and CPI (significant coefficients 0.73 and 0.63 respectively). This implies that a higher initial level of GDS and CPI is associated with a higher growth rate of the sector. The positive contribution of CPI to growth in the sector may be a result of higher prices bringing higher revenue and thus an inducement to invest in the sector. On the other hand, conditional on other variables, convergence cannot be exclusively established in the secondary sector, as the coefficient of $PCSGDP_{t-1}$ is not significant in three models. However, the negative value of the independent variable (only the coefficient of the FE model is significant, −0.304; Table 14) in all the models could be hinting at conditional β-convergence in the sector.

Table 13: Empirical results of Equation 15 for PCPGDP in the CMA

Dependent variable: λPCPGDP	Poolability test		Hausman test	
	F (3, 57) = 8.23, Prob > F = 0.000		χ2 = 24.76, Prob > χ2 = 0.009	
Variables/model	**FE**	**RE**	**FGLS**	**PCSE**
Constant	1.894	−0.025	−0.025	−0.102
	(1.442)	(0.271)	(0.247)	(0.233)
$PCGDP_{t-1}$	−0.781*	−0.131*	−0.131**	−0.112***
	(0.142)	(0.058)	(0.053)	(0.065)
EXP_{t-1}	−0.047	0.048	0.048	0.021
	(0.106)	(0.121)	(0.110)	(0.124)
IMP_{t-1}	−0.054	0.143	0.143	0.151***
	(0.103)	(0.111)	(0.101)	(0.084)
$EXCH_{t-1}$	0.047	−0.032	−0.032	−0.058
	(0.077)	(0.088)	(0.080)	(0.068)
$BRMO_{t-1}$	0.138	0.033	0.033	0.006
	(0.133)	(0.096)	(0.088)	(0.081)
$DEBT_{t-1}$	−0.051	−0.032	−0.032	−0.020
	(0.063)	(0.061)	(0.055)	(0.051)
$GFCE_{t-1}$	0.118	−0.182	−0.182	−0.156***
	(0.204)	(0.118)	(0.107)	(0.110)
GDS_{t-1}	0.054	0.073***	0.073***	0.068
	(0.040)	(0.044)	(0.040)	(0.053)
$REIR_{t-1}$	0.023	0.009	0.009	0.004
	(0.033)	(0.037)	(0.033)	(0.033)
$NARR_{t-1}$	0.008	−0.085	−0.085	−0.084
	(0.039)	(0.038)	(0.035)	(0.031)
CPI_{t-1}	−0.126	0.063**	0.063*	0.084*
	(0.172)	(0.090)	(0.082)	(0.083)
	R^2 = 0.003 F = 3.38 Prob > F = 0.001	R^2 = 0.134 Wald χ^2 = 9.29 Prob>χ^2 = 0.595	Wald χ^2 = 11.15 Prob > χ^2 = 0.431	R^2 = 0.138 Wald χ^2 = 10.52 Prob > χ^2 = 0.484

Note: *, **, and *** represent significance at 1%, 5%, and 10% respectively; figures in parentheses are respective standard errors; GDP is at 2010 constant prices.

Source: authors' construction based on data from WDI (2020f).

The variables that affect the growth of the secondary sector positively are debt and GDS, while a higher level of EXP is inversely associated with the growth of the sector. The positive impact of saving may be due to the availability of funds for investment (which is not affected by loans from government) in a sector that sees increased growth. On the other hand, a higher level of exports may indicate that the resources from the sector are drawn towards another sector—namely the tertiary sector (EXP, as predicted, is a positive determinant of growth in the tertiary sector).

Table 14: Empirical results of Equation 15 for PCSGDP in the CMA

Dependent variable: λPCSGDP		Poolability test		Hausman test
		F (3, 57) = 4.58, Prob > F = 0.006		χ2 = 13.86, Prob > χ2 = 0.240
Variables/model	**FE**	**RE**	**FGLS**	**PCSE**
Constant	1.294 (0.777)	0.058 (0.139)	0.058 (0.127)	0.051 (0.094)
$PCGDP_{t-1}$	−0.304* (0.102)	−0.032 (0.040)	−0.032 (0.036)	−0.034 (0.038)
EXP_{t-1}	−0.057* (0.064)	−0.052* (0.067)	−0.052* (0.061)	−0.047* (0.071)
IMP_{t-1}	0.022 (0.060)	0.060 (0.061)	0.060 (0.056)	0.059 (0.049)
$EXCH_{t-1}$	−0.146 (0.044)	−0.135 (0.048)	−0.135 (0.043)	−0.141 (0.052)
$BRMO_{t-1}$	0.064 (0.078)	−0.030 (0.042)	−0.030 (0.039)	−0.031 (0.036)
$DEBT_{t-1}$	0.070** (0.037)	0.068** (0.033)	0.068** (0.030)	0.074** (0.033)
$GFCE_{t-1}$	−0.037 (0.132)	−0.010 (0.057)	−0.010 (0.052)	−0.014 (0.049)
GDS_{t-1}	0.071* (0.024)	0.071* (0.022)	0.071* (0.020)	0.072* (0.025)
$REIR_{t-1}$	0.031 (0.019)	0.029 (0.020)	0.029 (0.018)	0.026*** (0.015)
$NARR_{t-1}$	0.016 (0.027)	−0.024 (0.020)	−0.024 (0.018)	−0.025 (0.015)
CPI_{t-1}	0.084 (0.104)	0.008 (0.054)	0.008 (0.050)	0.012 (0.058)
	R^2 = 0.061 F = 4.15 Prob > F = 0.000	R^2 = 0.331 Wald χ^2 = 29.71 Prob > χ^2 = 0.001	Wald χ^2 = 35.65 Prob > χ^2 = 0.000	R^2 = 0.358 Wald χ^2 = 28.77 Prob > χ^2 = 0.002

Note: *, **, and *** represent significance at 1%, 5%, and 10% respectively; figures in parentheses are respective standard errors; GDP is at 2010 constant prices.

Source: authors' construction based on data from WDI (2020f).

The empirical results on the tertiary sector of the region support conditional β-convergence (the coefficients are −0.216, −0.119, −0.119, and −0.140 for the FE, RE, FGLS, and PCSE models respectively; Table 15). The positive contributors to the growth of the sector are EXP, EXCH, and BRMO, while variables such as IMP, DEBT, and GDS affect growth negatively. The positive contribution of the bilateral exchange rate and BRMO may be due to the competitive advantage that economies might gain in the international market as a result of the depreciation of the currency and the increase in domestic money supply, while the negative contribution of DEBT and GDS may simply be due to the prevalence of the 'crowding-out effect' and 'paradox of thrift' in the region.

Table 15: Empirical results of Equation 15 for PCTGDP in the CMA

Dependent variable: λPCTGDP		Poolability test		Hausman test
		F (3, 57) = 1.18, Prob > F = 0.325		χ2= 3.54, Prob> χ2 = 0.981
Variables/model	**FE**	**RE**	**FGLS**	**PCSE**
Constant	−0.302 (1.010)	0.005 (0.170)	0.005 (0.156)	−0.172 (0.164)
$PCGDP_{t-1}$	−0.216* (0.084)	−0.119* (0.047)	−0.119* (0.043)	−0.140* (0.047)
EXP_{t-1}	0.178** (0.088)	0.207* (0.063)	0.207* (0.057)	0.224* (0.069)
IMP_{t-1}	−0.127*** (0.074)	−0.119 (0.073)	−0.119*** (0.066)	−0.093 (0.065)
$EXCH_{t-1}$	0.083 (0.058)	0.097*** (0.057)	0.097*** (0.052)	0.102*** (0.056)
$BRMO_{t-1}$	0.120 (0.099)	0.216*** (0.083)	0.216* (0.075)	0.230* (0.084)
$DEBT_{t-1}$	−0.102** (0.047)	−0.094* (0.039)	−0.094* (0.036)	−0.080** (0.039)
$GFCE_{t-1}$	0.031 (0.159)	−0.083 (0.054)	−0.083*** (0.050)	−0.114** (0.055)
GDS_{t-1}	−0.072** (0.031)	−0.070** (0.030)	−0.070* (0.027)	−0.067** (0.034)
$REIR_{t-1}$	−0.023 (0.025)	−0.019 (0.024)	−0.019 (0.022)	−0.021 (0.022)
$NARR_{t-1}$	−0.008 (0.027)	−0.016 (0.026)	−0.016 (0.024)	−0.030 (0.022)
CPI_{t-1}	0.126 (0.142)	0.089 (0.060)	0.089 (0.055)	0.129** (0.062)
	R^2 = 0.159 F = 3.34 Prob > F = 0.001	R^2 = 0.381 Wald χ^2 = 36.97 Prob > χ^2 = 0.000	Wald χ^2 = 44.36 Prob > χ^2 = 0.000	R^2 = 0.416 Wald χ^2 = 35.10 Prob > χ^2 = 0.000

Note: *, **, and *** represent significance at 1%, 5%, and 10% respectively; figures in parentheses are respective standard errors; GDP is at 2010 constant prices.

Source: authors' construction based on data from WDI (2020f).

The results on conditional β-convergence for the RSA are presented in Tables 16 to 19. Table 16 reveals that the nine provinces of the RSA experienced conditional β-convergence during the period at aggregate level (the coefficients of the independent variable are −0.146, −0.026, −0.025, and −0.021 in the FE, RE, FGLS, and PCSE models respectively). The positive and significant coefficient of CPI in the FGLS model (the coefficient is 0.022) could be suggestive of an expansionary monetary policy in the RSA aimed at promoting the growth of the provinces. However, the result of the FGLS model suggests that expenditure of the provinces on social development, and salaries and wages, reduces the growth of the provinces. Thus, the provinces need to be careful while spending on the revenue account of their budget.

Table 16: Empirical results of Equation 15 for PCGDP in the RSA

Dependent variable: λPCGDP	Poolability test		Hausman test	
	F (8, 148) = 1.49, Prob > F = 0.164		χ^2 = 12.07, Prob > χ^2 = 0.600	
Variables/model	**FE**	**RE**	**FGLS**	**PCSE**
Constant	1.353**	0.292	0.307*	0.251
	(0.536)	(0.199)	(0.122)	(0.196)
$PCGDP_{t-1}$	−0.146*	−0.026***	−0.025*	−0.021***
	(0.054)	(0.014)	(0.009)	(0.013)
TAX_{t-1}	−0.004	−0.001	0.002	−0.001
	(0.005)	(0.004)	(0.001)	(0.002)
$SGSOCA_{t-1}$	−0.009	0.003	0.008	0.006
	(0.020)	(0.010)	(0.006)	(0.008)
TR_{t-1}	−0.002	−0.001	−0.000	−0.001
	(0.002)	(0.002)	(0.001)	(0.001)
$IDRL_{t-1}$	0.006	0.003	0.002	0.004
	(0.004)	(0.003)	(0.001)	(0.003)
EDU_{t-1}	0.013	−0.008	−0.009	−0.004
	(0.027)	(0.019)	(0.010)	(0.016)
$HEALTH_{t-1}$	−0.022	0.003	0.003	−0.003
	(0.033)	(0.022)	(0.012)	(0.018)
$SOCDEV_{t-1}$	−0.011	−0.007	−0.009**	−0.008
	(0.008)	(0.007)	(0.004)	(0.006)
$TRANS_{t-1}$	0.008	−0.002	−0.005	−0.005
	(0.010)	(0.007)	(0.003)	(0.006)
SW_{t-1}	0.016	−0.006	−0.010*	−0.004
	(0.012)	(0.009)	(0.004)	(0.007)
TS_{t-1}	0.011	0.005	0.004	0.006
	(0.016)	(0.013)	(0.007)	(0.012)
$LSSA_{t-1}$	−0.003	−0.001	0.000	−0.002
	(0.002)	(0.001)	(0.001)	(0.002)
$SOIA_{t-1}$	−0.001	0.001	−0.000	0.001
	(0.003)	(0.003)	(0.001)	(0.003)
CPI_{t-1}	0.027	0.019	0.022***	0.015
	(0.020)	(0.019)	(0.012)	(0.021)
	R^2 = 0.0670	R^2 = 0.1116	Wald χ^2 = 47.68	R^2 = 0.1355
	F-test = 1.73	Wald χ^2 = 19.59	Prob > χ^2 = 0.000	Wald χ^2 = 22.11
	Prob > F = 0.054	Prob > χ^2 = 0.143		Prob > χ^2 = 0.076

Note: *, **, and *** represent significance at 1%, 5%, and 10% respectively; figures in parentheses are respective standard errors.

Source: authors' construction based on data from National Treasury (2020); SSA (2020a, b, c).

With respect to the primary sector of the provinces, though nothing can be said conclusively, the negative coefficients of $PCPGDP_{t-1}$ in all the models may hint at the prevalence of conditional convergence (the coefficient is significant only in the FE model; Table 17). However, if we look at the FGLS model, the variables that contribute positively to the growth of the province in the sector are expenditure on education, health, and software (Table 17). This shows the importance of human capital (education and health as a merit good) and information and communication technology (ICT) in promoting the growth of the sector. Therefore, the poorer provinces should be encouraged to promote the use of ICT (which requires education) in the primary sector to enhance growth. Similarly, the positive effect of revenue generated from the sales of goods and services other than capital assets (the coefficient is 0.034) justifies a policy of government intervention in economic activities. The negative effect of tax on the growth rate should encourage the provinces towards tax reduction (an expansionary fiscal policy) to achieve higher growth, whereas the similar effect of expenditure on salaries and wages on growth is a caution to the provinces to reduce revenue expenditure.

Table 17: Empirical results of Equation 15 for PCPGDP in the RSA

Dependent variable: λPCPGDP		Poolability test F (8, 148) = 1.82, Prob > F = 0.078		Hausman test χ^2 = 16.20, Prob > χ^2 = 0.301
Variables/model	**FE**	**RE**	**FGLS**	**PCSE**
Constant	1.174*	−0.117	−0.166	−0.083
	(0.489)	(0.219)	(0.128)	(0.212)
$PCPGDP_{t-1}$	−0.166*	−0.010	−0.001	−0.008
	(0.051)	(0.007)	(0.005)	(0.007)
TAX_{t-1}	−0.008	−0.007	−0.005**	−0.006
	(0.009)	(0.008)	(0.002)	(0.004)
$SGSOCA_{t-1}$	0.019	0.027	0.034*	0.032**
	(0.034)	(0.020)	(0.010)	(0.014)
TR_{t-1}	0.001	−0.001	−0.000	0.000
	(0.003)	(0.003)	(0.001)	(0.002)
$IDRL_{t-1}$	0.007	0.003	0.002	0.002
	(0.007)	(0.006)	(0.002)	(0.004)
EDU_{t-1}	0.056	0.063**	0.048*	0.061**
	(0.046)	(0.031)	(0.019)	(0.028)
$HEALTH_{t-1}$	0.077	0.052	0.040***	−0.053
	(0.057)	(0.040)	(0.023)	(0.035)
$SOCDEV_{t-1}$	−0.011	−0.007	−0.002	−0.009
	(0.015)	(0.013)	(0.008)	(0.012)
$TRANS_{t-1}$	−0.004	−0.008	−0.010	−0.013
	(0.017)	(0.014)	(0.007)	(0.012)
SW_{t-1}	0.017	−0.012	−0.015**	−0.010
	(0.022)	(0.016)	(0.008)	(0.014)
TS_{t-1}	0.025	0.013	0.002	0.014
	(0.028)	(0.023)	(0.014)	(0.020)
$LSSA_{t-1}$	−0.005	−0.004	0.001	−0.004
	(0.004)	(0.003)	(0.002)	(0.003)
$SOIA_{t-1}$	0.005	0.010***	0.004**	0.007***
	(0.005)	(0.005)	(0.002)	(0.004)
CPI_{t-1}	0.022	0.020	0.034**	0.016
	(0.034)	(0.034)	(0.018)	(0.031)
	R^2 = 0.0094 F-test = 1.45 Prob > F = 0.136	R^2 = 0.0895 Wald χ^2 = 15.33 Prob > χ^2 = 0.356	Wald χ^2 = 56.66 Prob> χ^2 = 0.000	R^2 = 0.1131 Wald χ^2 = 27.26 Prob> χ^2 = 0.017

Note: *, **, and *** represent significance at 1%, 5%, and 10% respectively; figures in parentheses are respective standard errors.

Source: authors' construction based on data from National Treasury (2020); SSA 2020a, b, c).

Similarly, the empirical results support conditional β-convergence in the secondary sector of the provinces (the negative coefficients of $PCSGDP_{t-1}$ in the FE and FGLS models are indicative of the presence of conditional β-convergence: the coefficients in the models are −0.185 and −0.013; Table 18**).** The significant and negative coefficient of revenue from tax and positive coefficient of revenue from interest, dividends, and rent on land (the coefficients are −0.004 and 0.005 for TAX_{t-1} and $IDRL_{t-1}$ respectively in the FGLS model) suggest that the lower disposable income of people in the provinces may deter growth, while the extension of debt to people may promote the growth of the sector. Thus, an expansionary fiscal policy may act as a tonic for the sector.

Table 18: Empirical results of Equation 15 for PCSGDP in the RSA

Dependent variable: λPCSGDP		Poolability test F (8, 148) = 2.24, Prob > F = 0.027		Hausman test χ^2 = 18.88, Prob > χ^2 = 0.169
Variables/model	**FE**	**RE**	**FGLS**	**PCSE**
Constant	1.476*	0.188	0.112	0.134
	(0.409)	(0.190)	(0.112)	(0.165)
$PCSGDP_{t-1}$	−0.185*	−0.017	−0.013**	−0.013
	(0.049)	(0.011)	(0.006)	(0.009)
TAX_{t-1}	0.001	−0.001	−0.004**	−0.003
	(0.006)	(0.005)	(0.002)	(0.003)
$SGSOCA_{t-1}$	−0.037	−0.005	0.001	0.000
	(0.023)	(0.013)	(0.007)	(0.010)
TR_{t-1}	−0.002	−0.001	−0.000	−0.001
	(0.002)	(0.002)	(0.001)	(0.001)
$IDRL_{t-1}$	0.004	0.003	0.005*	0.004
	(0.005)	(0.004)	(0.002)	(0.003)
EDU_{t-1}	−0.042	−0.022	−0.019	−0.018
	(0.032)	(0.028)	(0.014)	(0.023)
$HEALTH_{t-1}$	0.041	0.020	0.019	0.020
	(0.040)	(0.033)	(0.017)	(0.025)
$SOCDEV_{t-1}$	−0.014	−0.010	−0.007	−0.011
	(0.010)	(0.009)	(0.005)	(0.009)
$TRANS_{t-1}$	−0.002	−0.007	−0.003	−0.011
	(0.012)	(0.010)	(0.004)	(0.008)
SW_{t-1}	0.017	−0.010	−0.007	−0.008
	(0.014)	(0.012)	(0.005)	(0.008)
TS_{t-1}	0.014	0.005	0.004	0.002
	(0.019)	(0.016)	(0.008)	(0.014)
$LSSA_{t-1}$	−0.003	−0.002	−0.001	−0.002
	(0.003)	(0.002)	(0.001)	(0.002)
$SOIA_{t-1}$	−0.004	−0.000	−0.002	−0.001
	(0.004)	(0.003)	(0.002)	(0.003)
CPI_{t-1}	0.037	0.031	0.021	0.032
	(0.023)	(0.023)	(0.016)	(0.023)
	R^2 = 0.0520	R^2 = 0.1356	Wald χ^2 = 43.47	R^2 = 0.1661
	F-test = 2.42	Wald χ^2 = 24.47	Prob > χ^2 = 0.000	Wald χ^2 = 27.47
	Prob > F = 0.004	Prob > χ^2 = 0.040		Prob > χ^2 = 0.016

Note: *, **, and *** represent significance at 1%, 5% and 10% respectively; figures in parentheses are respective standard errors.

Source: authors' construction based on data from National Treasury (2020); SSA 2020a, b, c).

Table 19 reveals that the tertiary sector of the provinces also exhibits conditional β-convergence (the estimated coefficients of $PCTGDP_{t-1}$ are negative and significant for the FE and FGLS models). This implies that the provinces of the RSA are converging to their own steady state in the tertiary sector, i.e., the further a province is from its steady state, the higher the growth is in the sector for the province. Since the tertiary sector is service-based, the higher expenditure on social sector development and transportation might have a negative effect on the growth of the sector (the coefficients of $SOCDEV_{t-1}$ and $TRANS_{t-1}$ are −0.012 and −0.006 in the FGLS model; Table 19). However, the positive contribution of expenditure on ICT (the coefficient for $SOIA_{t-1}$ is positive and significant, 0.003 for the sector) signifies the importance of ICT in enhancing growth in the tertiary sector. Higher revenue for the provinces from tax and sales of goods and services other than capital assets might be creating greater liberty to implement progressive reforms in the tertiary sector, leading to higher growth.

Table 19: Empirical results of Equation 15 for PCTGDP in the RSA

Dependent variable: λPCTGDP		Poolability test F (8, 148) = 1.9, Prob > F = 0.063		Hausman test χ^2 = 15.76, Prob > χ^2 = 0.328
Variables/model	**FE**	**RE**	**FGLS**	**PCSE**
Constant	1.247*	0.188	0.185***	0.128
	(0.505)	(0.198)	(0.109)	(0.183)
$PCTGDP_{t-1}$	−0.143*	−0.014	−0.013***	−0.009
	(0.056)	(0.015)	(0.008)	(0.014)
TAX_{t-1}	0.002	0.002	0.004*	0.002
	(0.005)	(0.004)	(0.001)	(0.002)
$SGSOCA_{t-1}$	−0.022	−0.000	0.009***	0.002
	(0.018)	(0.010)	(0.006)	(0.008)
TR_{t-1}	−0.001	−0.001	−0.000	−0.001
	(0.002)	(0.001)	(0.001)	(0.001)
$IDRL_{t-1}$	0.005	0.002	0.002	0.004
	(0.004)	(0.003)	(0.001)	(0.003)
EDU_{t-1}	−0.006	−0.007	0.001	0.002
	(0.027)	(0.021)	(0.013)	(0.017)
$HEALTH_{t-1}$	0.001	−0.004	−0.013	−0.014
	(0.035)	(0.025)	(0.014)	(0.018)
$SOCDEV_{t-1}$	−0.012	−0.008	−0.012*	−0.008
	(0.008)	(0.006)	(0.004)	(0.006)
$TRANS_{t-1}$	0.008	−0.002	−0.006***	−0.004
	(0.009)	(0.007)	(0.004)	(0.006)
SW_{t-1}	0.018	−0.003	−0.005	−0.000
	(0.011)	(0.009)	(0.004)	(0.007)
TS_{t-1}	0.015	0.007	0.008	0.006
	(0.015)	(0.012)	(0.007)	(0.012)
$LSSA_{t-1}$	−0.003	−0.001	−0.000	−0.002
	(0.002)	(0.001)	(0.001)	(0.002)
$SOIA_{t-1}$	−0.004	−0.002	0.003***	−0.002
	(0.003)	(0.003)	(0.002)	(0.002)
CPI_{t-1}	0.022	0.015	0.018	−0.014
	(0.019)	(0.018)	(0.012)	(0.019)
	R^2 = 0.0475 F-test = 2.19 Prob > F = 0.010	R^2 = 0.1163 Wald χ^2 = 20.54 Prob > χ^2 = 0.114	Wald χ^2 = 62.22 Prob > χ^2 = 0.000	R^2 = 0.1279 Wald χ^2 = 30.57 Prob > χ^2 = 0.006

Note: *, **, and *** represent significance at 1%, 5% and 10% respectively; figures in parentheses are respective standard errors.

Source: authors' construction based on data from National Treasury (2020); SSA 2020a, b, c).

To summarize, it can be said that the economies of the CMA and the provinces of the RSA experience β-convergence (both absolute and conditional) at aggregate as well as sectoral level, i.e., the economies are converging to a common steady state (absolute convergence) and to their own steady-state level (conditional convergence). The presence of convergence in the economies of the CMA and provinces of the RSA raises the second issue, i.e. whether inequality between the economies and between the provinces is declining over time (σ-convergence). Therefore, the concept of σ-convergence in the region is empirically tested by estimating Equation 16;[13] the results are presented in Tables 20 and 21. The fairly acceptable value of R^2 and adjusted-R^2 and the significant F-values (these values are low for the regression of the primary sector for both the

[13] Equation 16 is estimated for all six measures of inequality calculated in this paper.

CMA and the RSA and for some measures of inequality, namely KM and TI, in the secondary sector for the CMA) indicates the acceptability of these models to estimate Equation 16.

Table 20 reveals that the coefficient of t for all the measures of inequality is negative and significant for the aggregate economy in the CMA. This implies that with the passage of time, economic inequality (measured in terms of per capita GDP) among the members of the CMA has been declining at aggregate level. However, with respect to the primary sector of the economy, the coefficient of t is not significant for any of the measures of inequality. In fact, the low value of R^2 and adjusted-R^2 with insignificant F-values indicates the non-acceptability of the regression model(s) for the sector. However, the coefficients of t are negative and significant for all the measures of inequality in the secondary and tertiary sectors in the CMA. This implies that inequality (in terms of per capita income) with respect to the secondary and tertiary sectors has been declining (prevalence of σ-convergence) in the region during the study period.

Table 20: Empirical results of Equation 16 for the CMA

	Dependent variable	Intercept	Coefficient of t	R^2 and adjusted-R^2	F-statistic Prob(F-statistic)
Aggregate	SDL	0.888* (0.0080)	−0.008* (0.0007)	0.884 0.877	129.783 0.000
	GC	0.302* (0.0018)	−0.003* (0.0001)	0.952 0.949	336.647 0.000
	MM	0.456* (0.0023)	−0.003* (0.0002)	0.945 0.942	295.199 0.000
	PM	0.225* (0.0016)	−0.003* (0.0001)	0.950 0.947	322.258 0.000
	KM	0.100* (0.0010)	−0.001* (0.0001)	0.934 0.930	242.135 0.000
	TI	0.170* (0.0017)	−0.002* (0.0001)	0.942 0.938	275.836 0.000
Primary	SDL	0.948* (0.0376)	−0.002 (0.0032)	0.021 −0.036	0.374 0.549
	GC	0.312* (0.0104)	0.001 (0.0009)	0.007 −0.051	0.119 0.734
	MM	0.483* (0.0139)	0.001 (0.0012)	0.005 −0.054	0.083 0.777
	PM	0.226* (0.0089)	0.001 (0.0008)	0.009 −0.049	0.150 0.703
	KM	0.114* (0.0068)	0.001 (0.0006)	0.013 −0.045	0.221 0.644
	TI	0.192* (0.0123)	0.001 (0.0010)	0.008 −0.050	0.146 0.707
Secondary	SDL	0.807* (0.0190)	−0.003** (0.0016)	0.215 0.169	4.652 0.046
	GC	0.277* (0.0068)	−0.004* (0.0006)	0.726 0.709	44.954 0.000
	MM	0.431* (0.0083)	−0.005* (0.0007)	0.712 0.695	42.041 0.000
	PM	0.200* (0.0061)	−0.004* (0.0005)	0.728 0.712	45.612 0.000
	KM	0.088* (0.0027)	−0.001* (0.0002)	0.576 0.551	23.084 0.000
	TI	0.147* (0.0047)	−0.002* (0.0004)	0.593 0.569	24.734 0.000
Tertiary	SDL	1.220* (0.0306)	−0.021* (0.0026)	0.782 0.769	61.067 0.000
	GC	0.445*	−0.005*	0.711	41.780

		(0.0098)	(0.0008)	0.694	0.000
	MM	0.635*	−0.007*	0.752	51.695
		(0.0118)	(0.0010)	0.738	0.000
	PM	0.349*	−0.004*	0.659	32.831
		(0.0090)	(0.0007)	0.639	0.000
	KM	0.210*	−0.005*	0.788	63.312
		(0.0070)	(0.0006)	0.776	0.000
	TI	0.366*	−0.009*	0.769	56.678
		(0.0133)	(0.0011)	0.756	0.000

Note: * and ** represent significance at 1% and 5%, respectively; figures in parentheses are respective standard errors; GDP is at 2010 constant prices.

Source: authors' construction based on data from WDI (2020f).

With respect to the empirical results on the trend of economic inequality (measured in terms of per capita income) among the provinces of the RSA, Table 21 reveals that the coefficients of t are negative and significant for all the measures of inequality at aggregate and sectoral levels (the coefficient is insignificant for TI in the primary sector: the coefficient is −0.001). Further, the R^2, adjusted-R^2, and significant F-values indicate the acceptability of all but one of the models. Therefore, we can conclude that there is a declining trend of income inequality among the provinces of the RSA, i.e. the presence of σ-convergence among the provinces.

Table 21: Empirical results of Equation 16 for the RSA

	Dependent Variable	**Intercept**	**Coefficients**	**R^2 and adjusted-R^2**	**F-statistic Prob(F-statistic)**
Aggregate	**SDL**	0.428*	−0.009*	0.906	173.305
		(0.0083)	(0.0006)	0.901	0.000
	GC	0.220*	−0.004*	0.890	145.730
		(0.0045)	(0.0003)	0.884	0.000
	MM	0.318*	−0.006*	0.899	160.986
		(0.0061)	(0.0005)	0.894	0.000
	PM	0.172*	−0.003*	0.874	125.208
		(0.0037)	(0.0003)	0.867	0.000
	KM	0.044*	−0.001*	0.891	146.894
		(0.0014)	(0.0001)	0.885	0.000
	TI	0.075*	−0.002*	0.885	138.292
		(0.0025)	(0.0002)	0.878	0.000
Primary	**SDL**	1.244*	−0.005*	0.480	16.613
		(0.0153)	(0.0012)	0.451	0.001
	GC	0.429*	−0.001*	0.343	9.409
		(0.0039)	(0.0003)	0.307	0.007
	MM	0.612*	−0.001***	0.152	3.232
		(0.0045)	(0.0003)	0.105	0.089
	PM	0.337*	−0.001*	0.424	13.239
		(0.0038)	(0.0003)	0.392	0.002
	KM	0.174*	−7.59E-05	0.006	0.115
		(0.0027)	(0.0002)	−0.049	0.738
	TI	0.316*	−0.001	0.133	2.772
		(0.0052)	(0.0004)	0.085	0.113
Secondary	**SDL**	0.710*	−0.010*	0.898	158.399
		(0.0097)	(0.0008)	0.892	0.000
	GC	0.360*	−0.005*	0.897	156.662
		(0.0050)	(0.0004)	0.891	0.000
	MM	0.493*	−0.006*	0.904	169.682
		(0.0058)	(0.0005)	0.899	0.000
	PM	0.293*	−0.005*	0.895	153.968
		(0.0046)	(0.0004)	0.889	0.000

	KM	0.114* (0.0028)	−0.003* (0.0002)	0.884 0.878	137.496 0.000
	TI	0.203* (0.0052)	−0.005 (0.0004)	0.885 0.879	139.196 0.000
Tertiary	**SDL**	0.438* (0.0090)	−0.006* (0.0007)	0.802 0.791	73.154 0.000
	GC	0.241* (0.0051)	−0.004* (0.0004)	0.808 0.797	75.837 0.000
	MM	0.320* (0.0072)	−0.005* (0.0006)	0.785 0.773	65.692 0.000
	PM	0.202* (0.0042)	−0.003* (0.0003)	0.817 0.806	80.172 0.000
	KM	0.055* (0.0020)	−0.001* (0.0002)	0.794 0.782	69.314 0.000
	TI	0.099* (0.0037)	−0.002* (0.0003)	0.787 0.775	66.387 0.000

Note: * and *** represent significance at 1% and 10% respectively; figures in parentheses are respective standard errors; GDP is at 2010 constant prices.

Source: authors' construction based on data from WDI (2020f).

To sum up, it can be said that the economies of the CMA and the provinces of the RSA have experienced low growth (Table 4 and Table 7), but the growth rates of the relatively poorer economies and provinces are higher than those of their richer counterparts (absolute β-convergence). Additionally, the economies which are further from their own steady-state level tended to grow faster than the economies which are closer to their steady-state level in the CMA and in the RSA (presence of conditional β-convergence) during the study period. This precondition for reduced inequality (at both aggregate and sectoral level) has, in fact, resulted in the reduction of inequality among the economies of the CMA and the provinces of the RSA (presence of σ-convergence).

6 Conclusion and policy suggestions

To conclude, it can be said that in the economies of the CMA, the growth rates of the initially poorer economies are greater than those of their richer counterparts, a situation of absolute β-convergence. Similarly, the region also experiences conditional β-convergence with respect to per capita GDP. The results reveal that the initial natural endowment (as represented by natural resources rent as a percentage of GDP, NARR) and government consumption expenditure have a negative impact on the growth performance of the regions. With respect to the primary and tertiary sectors, the growth determinants are exports, broad money, and GDS. Further, CPI affects growth positively in the primary sector, while GFCE and NARR are the negative determinants of growth. In the secondary sector, the variable that affects growth inversely is exports; however, variables such as public debt and GDS improve the growth rate of the economies. The results reveal that the tertiary sector is more sensitive to endowment as well as policy variables in the economies of the CMA during the study period. Further, it is evident that inequality in the region has declined over the study period both at the aggregate GDP level and at the sectoral level.

The analysis of the provincial data for the RSA reveals that the growth rate of the initially poorer provinces is greater than that of their richer counterparts, i.e. a situation of absolute β-convergence. The results support conditional β-convergence at the aggregate level. The per capita revenue received from interest, dividends, and rent on land has a positive impact on the per capita growth rate, whereas per capita expenditure on social development and on salaries and wages has a negative impact on per capita growth. The analysis of σ-convergence reveals that the economy at aggregate and sectoral levels has experienced reduced inequality among the provinces.

The tertiary sector is more sensitive to endowment as well as policy variables in the economies of the CMA. This implies that policy-makers in the region can target the tertiary sector to achieve growth-accompanied convergence rather than growth-devoid convergence in the region. Inflation targeting could be a successful policy option to reduce inequality in the region but must be used selectively (with administered price for some 'left-behind' sectors like the primary sector) and carefully, as reduced prices may reduce growth in some sectors. For the provinces of the RSA, sector-specific expansionary fiscal policies need to be adopted. Further, capital expenditure on key sectors such as education and health can stimulate growth. However, the provinces need to manage and maintain the capital budget with limited revenue expenditure, as excess revenue expenditure can put pressure on the fiscal position of the provinces.

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