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ECONOMIC, DIPLOMATIC AND CULTURAL CHALLENGES

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CONTENT

CATCHING-UP THEORY: EXAMINING SOUTH AFRICA'S ECONOMIC DEVELOPMENT

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INTRODUCTION

The convergence debate gained traction during the 1980's and stems from the need of economists to answer several questions; one such is whether poor countries will continue to be poor in the longer term or will they catch up and be the rich nations of tomorrow. Sala-i-Martin (1996) posits that there are two reasons for the increase in popularity to investigate; firstly, it was put forward to test the validity of modern theories of economic growth and enabled the calculation of time estimates for convergence across economies. Secondly, macroeconomic data became more widely available that allowed international comparability across many nations therefore enabling to plot the evolution of growth levels over a period (Sala-i-Martin, 1996). The investigation into the evolution of these growth levels gives impetus to the convergence hypothesis predicting that poor nations will develop at a higher rate than richer nations that are at a steady state output level, given the assumption that the only difference between them are the initial levels of capital. The poor nation who initially starts farther away from their steady state, however as levels of capital increase, the economy grows rapidly then the growth rate starts to decline as it reaches its steady state.

Barro & Sala-i-Martin, 1991; Mankiw et al., 1992; Sala-i-Martin, 1996; Sahoo et al., 2010; Zeng, 2015; Lengyel & Kotosz, 2018; Monfort & Nicolini, 2000; and Kanó & Lengyel, 2021 have extensively investigated convergence patterns of developed economies in Europe and North America; to a lesser extent developing economy's focusing largely on Asia. To the best of this researcher's knowledge, there is sparsity of empirical studies investigating the phenomena in an African context. Therefore, the aim of this paper is to add to the discourse

by investigating the economic development of the Republic of South Africa (hereafter referred to as South Africa), through the lens of convergence theory as it is widely acknowledged as the most structurally advanced economy in Africa. According to the World Bank, South Africa is classified as an upper middle-income country and therefore as an emerging economy, it is justifiable to comparatively analyse its economic performance with that of the developed economies that collectively constitute the OECD which also comprises of four nations that are classified as upper-middle income (Columbia, Costa Rica, Mexico, and Turkey). Furthermore, the continents of Asia, Australasia, Central Eastern Europe, Western Europe, North America, and South America are represented in this group of countries.

Table 1: Study population

32 OECD member countries				
Australia	Denmark	Ireland	New Zealand	Switzerland
Austria	Finland	Israel	Norway	Turkey
Belgium	France	Italy	Poland	United Kingdom
Canada	Germany	Japan	Portugal	United States
Chile	Greece	Luxembourg	South Korea	
Columbia	Hungary	Mexico	Spain	
Costa Rica	Iceland	Netherlands	Sweden	
6 Control countries				
Argentina	Bahamas	Barbados	Panama	Trinidad and Tobago
Uruguay				
1 Comparative analysis country				
South Africa				

Source: Author's own construction

Amongst the OECD members are 6 post-socialist countries (PSC) namely, Czechia, Estonia, Latvia, Lithuania, Slovenia, and Slovakia all of which have a 10-year gap in their available data from 1980-1990 which amounts to a loss of 360 observations for the 6 variables. This

posed difficulties for the stability and reliability of the analysis of the unbalanced panel dataset. This has been solved by the removal of the 6 PSC and introducing 6 control Latin American countries which have similar World Bank classifications. This paper sheds new light in this area from an African perspective as it comparatively analyses 39 countries: South Africa, 6 Latin American countries and the 32 Organisation for Economic Cooperation and Development (OECD) members. It investigates their respective average steady state equilibriums and tests convergence patterns from 1980 to 2019. This will allow South Africa's developmental performance to be plotted relative to an international benchmark.

THEORETICAL BACKGROUND

The Solow-Swan model (1956) is used as the foundational theory for investigation into economic growth and convergence when determining the steady state equilibrium of countries. Moreover, the Sala-i-Martin (1996) application of beta (β), alpha (α) and conditional convergence as measurements to test convergence of regions and countries (Saba & Ngepah, 2020). Neoclassical growth model predicts "that the growth rate of an economy will be positively related to the distance that separates it from its own steady state. This is the concept known in the classical literature as conditional β-convergence. There is absolute β-convergence if poor countries tend to grow faster than rich ones" (Sala-i-Martin, 1996:1020). Sala-i-Martin (1996:1020) further elaborates that α-convergence can be defined as "a group of economies are converging in the sense of if the dispersion of their GDP per capita levels tends to decrease over time". Analysis on a growth equation using the Solow-Swan model (1956) is "derived as a log-linear approximation, from the transition path of the neoclassical growth model for closed economies" (Barro & Sala-i-Martin, 1991:108). The Cobb-Douglas production function, $Y(t) = K(t) \propto [A(t)L(t)]1-\propto Y(t)$, is applied and "convergence coefficient, β, depends on the productivity of capital and the willingness to save. In particular, the source of convergence in the neoclassical growth model is the assumed dimin-

ishing returns to capital. If the ratio of capital (and hence output) to effective labor declines relative to the steady-state ratio, then the marginal product of capital rises. Therefore, for a given saving behavior, an economy grows faster the further it is below the steady state" (Barro & Sala-i-Martin, 1991:109).

Using the aforementioned as a theoretical base, contemporary economic growth theory has made use of aggregated models to measure economic growth with these approaches focussing on whether or not there has been an increase in equilibrium Gross Domestic Product (GDP) per capita over a period of time, identifying the economic factors which exerts an influence (Ascani, et al., 2012). Moreover, the neoclassical Solow-Swan growth model of the 1950's has been the blueprint for the furtherance of economic theory and the drafting of policies for institutions around the world, where economic development was viewed as being a linear process which could be influenced by adjusting certain factors. This simplified view pays no attention to the multiplex social, institutional or historical elements which are qualitative in nature that contribute to the advancement of an economy. Endogenous growth theorists such as Solow in the late 1980's and Romer in his work during the 1990's asserted that technological innovation was at the core of economic growth processes in the long term (Ascani, et al., 2012). This piece of work applies the principles and assumptions established in endogenous growth theory.

METHODOLOGY

The intended aim of this research is to contribute to the existing discourse through the application of econometrics to analyse the economic development of South Africa. This analysis is done over a thirty-nine-year period 1980-2019 where the economic development of South Africa is compared to the OECD and the Latin American control group of countries. The source of the secondary data for this analysis is the Penn World Tables 10.0 where data for 6 variables of the 39 countries from 1980 until 2019 was converted into panel data to enumerate the preliminary β-convergence and α-convergence. The

sample of 39 countries is seen as one population extracted data was manually converted into a balanced panel dataset. This has resulted in a sample of 1554 observations for the period 1980-2019, where aggregate national capital stock at current PPP; expenditure-side real GDP at current PPP; number of persons engaged; output-side real GDP at chained PPP; share of gross capital formation at current PPP; and share of labour compensation in GDP at current national prices was analysed to illustrate this macroeconomic phenomenon.

Table 2: Macroeconomic variables of study

Macroeconomic variable	**Measurement**	**Source**
Capital stock at current PPPs	Millions in USD	Penn World Table 10.0
Expenditure-side real GDP at current PPPs	Millions in USD	Penn World Table 10.0
Number of persons engaged		Penn World Table 10.0
Output-side real GDP at chained PPPs	Millions in USD	Penn World Table 10.0
Share of gross capital formation at current PPPs	Millions in USD	Penn World Table 10.0
Share of labour compensation in GDP at current national prices	Millions in USD	Penn World Table 10.0

Author's own construction from Penn World Table 10.0

The choice of these variables was guided by the literature and are deemed the most appropriate to test the Solow-Swan model (1956) and calculate convergence (Blonigen, 2005; Head & Rise, 2008). Sala-i-Martin (1996) illustrates that to enumerate economic convergence it is necessary to include "GDP per capita for a cross-section of economies", for this paper the economies are South Africa, the control Latin American countries and the OECD. The Solow-Swan model centres around four variables: output (Y), capital (K), labour (L) and

'knowledge' or the 'effectiveness of labour' (A). Output changes over time only if inputs into the production process changes. If output increases over time (t) with the given levels of capital and labour, this is seen as technological progress in terms of improvements in the effectiveness of labour (labour augmenting or Harrod-neutral). Meaning that improved allocation of resources in the production process has resultant in increases in output. The production function is expressed as:

$$Y(t)=F(K)\,(t),\ A(t),\ L(t) \qquad (1)$$

The steady state equilibrium levels of each country will be calculated following the Solow-Swan model (1956). The equation below illustrates the computational logic of the model.

$$y = \left(\frac{\delta}{\sigma+g+n}\right)^{\frac{\propto}{1-\propto}} \qquad (2)$$

The Sala-i-Martin (1996) derivative of β-convergence and α-convergence as measurement to test convergence of regions and countries was applied. The neoclassical growth model predicts "that the growth rate of an economy will be positively related to the distance that separates it from its own steady state. This is the concept known in the classical literature as conditional β-convergence. There is absolute β-convergence if poor countries tend to grow faster than rich ones" (Sala-i-Martin, 1996:1027).

RESULTS

The complete Solow model (1956) is depicted as:

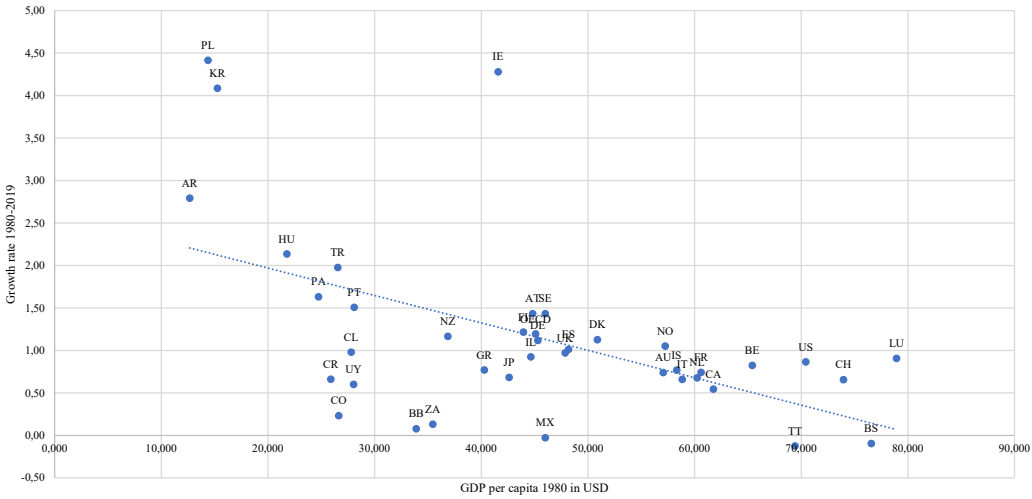
$$Y_{i,t,t+T} = \alpha - \beta log(\gamma_{i,t}) + \epsilon_{i,t} \qquad (3)$$

The equation above is expanded to $Y_i, t, t+T - \log\,(Y_i, t + \frac{T}{Y_i}, t)/T$

t) be economy *i's* annualised growth rate of GDP between t and t+T, and let log(y,t) be the logarithm of economy *i's* GDP per capita at time t" (Sala-i-Martin, 1996:1020). Based on the foundational equa-

tions mentioned in section 3 (methodology), the β-convergence and α-convergence calculations were computed and produced the following results.

Figure 1: Growth rate 1980-2019 v GDP per capita 1980 USD



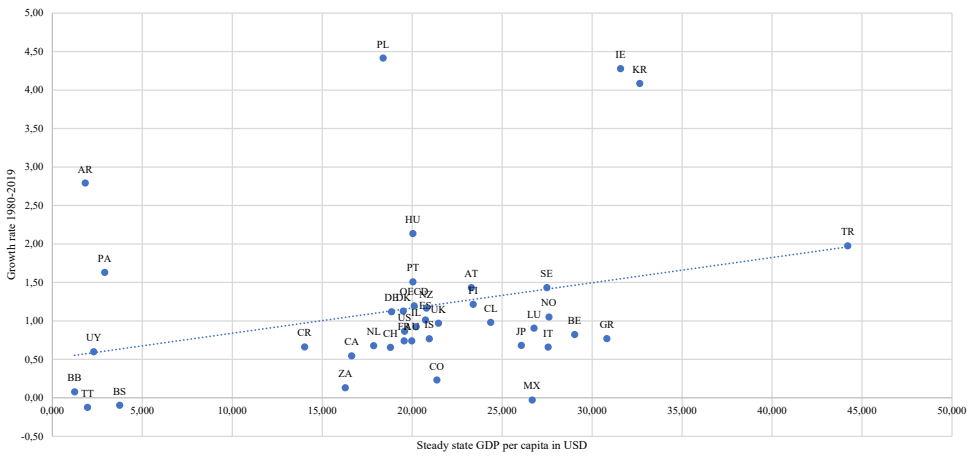
Author's own construction

The scatterplot visually illustrates the GDP per capita 1980 versus the growth rate 1980-2019 for the population of 39 countries including the OECD average. Several countries are observed to have formed more than one group, with Finland, Iceland, the Netherlands, and the OECD average (in green) positioned on the trendline which indicates that those economies have been performing at their respective steady state equilibrium levels. A larger number of these countries find themselves just below or below the trendline, indicating that they are performing below their steady state equilibrium levels. Fewer countries are positioned above the trendline most notably the outliers of Poland, South Korea, and Ireland whose growth rates are almost more than double the OECD average, indicating that they experienced absolute β-convergence. The relation between growth and the initial

income level in 1980 for the OECD countries is considerably negative as shown by downward trendline in figure 1. South Africa being positioned far below the trendline, highlighted in red, indicates that its economic performance is lagging the OECD benchmark, which for this analysis becomes the new steady state equilibrium level. Being at the point furthest away from the steady state, South Africa in future, through further industrialisation has the potential to attain higher levels of growth reaching the benchmark (Eberts, 1990; Altman & Mayer, 2003; Fedderke & Garlick, 2008; Grigoras, 2015; Kurniawati, 2020; Nagy, et al., 2020). Thus, attaining absolute convergence as per the convergence hypothesis.

According to Solow (1956), constant returns to scale is applicative to capital and effective labour, also referred to as technology. Meaning that if there in an increase in K or A it will result in a proportionate increase in Y. These increases potentially result an economy reaching a new steady state level, y* and an improvement in its GDP per effective worker, A*.

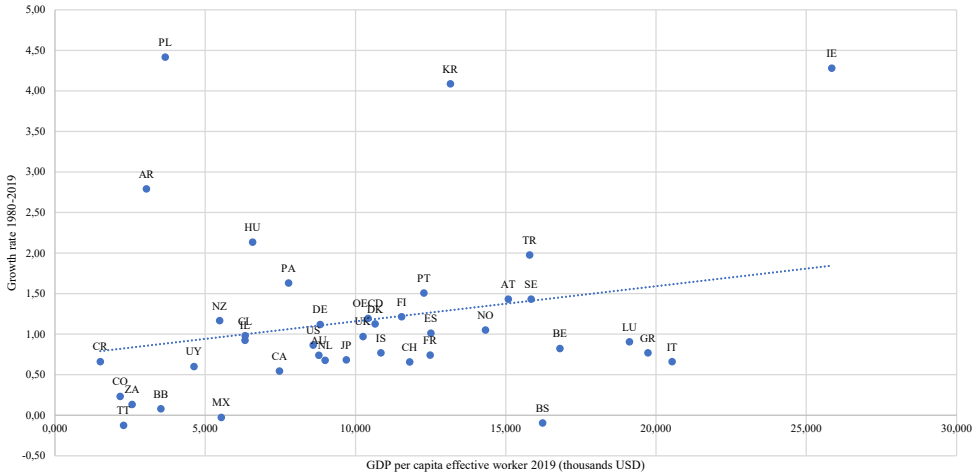
Figure 2: Steady state GDP per capita USD v growth rate 1980-2019



Author's own construction

Figure 2 demonstrates the potential steady state equilibrium (y*) that could be reached by each of the countries. Several countries are observed to have formed clusters, as seen in figure 1, with Sweden, Finland, Germany, and the OECD average (in green) positioned on the trendline which indicates that those economies have been performing at their respective steady state equilibrium levels. Fewer countries are positioned above the trendline most notably the outliers of Poland, South Korea, and Ireland whose growth rates are again almost more than double the OECD average, indicating that they experienced absolute -convergence. The relation between growth over the 39-year period and the steady state for the OECD countries is positive as shown by the steep upward trendline in figure 2. Also showing that the growth rate of the group of countries are approaching the steady state level at a relatively similar growth rate, thereby reducing dispersion. South Africa (in red) yet again is observed to be positioned far below the trendline indicating that its economic performance is lagging the OECD benchmark. This leaves room for South Africa to improve its economic performance through technological advancements in labour or increases in capital, based on the parameters of the model and in time reaching the OECD average steady state equilibrium level. However, this conditional -convergence shows that South Africa is moving away from its low initial GDP toward a higher GDP level potentially at a faster rate therefore closing the per capita income divergence between itself and those developed economies.

Figure 3: GDP per effective worker v growth rate 1980-2019



Author's own construction

According to the Solow model, constant returns to scale is applicative to capital and effective labour, also referred to as technology. Meaning that if there is an increase in K or A it will result in a proportionate increase in Y. These increases potentially result an economy reaching a new steady state level, y* and an improvement in its GDP per effective worker, A* as demonstrated in figure 3 above. The OECD average (in green) is the new steady state equilibrium point as it is positioned on the flatter trendline, the individual countries are observed to be in distributed positions with less clustering implying varying growth rates.

South Africa (in red) finds itself well below this point. This purports the presence of multifaceted disparities between South Africa and the OECD (Rogerson, 1997; Gibb, 2007; Wehner, 2000; Rogerson & Rogerson, 2010; Young, 2013).

Through the estimation of the β-coefficient, the speed of convergence can be calculated which is the amount of time in years that it will take South Africa to reach the OECD average GDP per capita.

Furthermore, half-life, is the "time required to cover half the road leading to full convergence within the study region if the speed of convergence remains unchanged" (Egri & Tánczos, 2018:53) and is calculated through the application of the equation 4 below. It estimates that it will take South Africa 67,5 years to reach the OECD average GDP per capita of 2019.

$$\pi = \frac{ln2}{\beta} \qquad (4)$$

CONCLUSION

This investigation delved into the growth patterns of 39 countries, South Africa and the 38 OECD countries and compared their performance over a period of 39 years from 1980-2019. Convergence analysis is considered to derive significant results when applied between countries that have similar economies (Sala-i-Martin, 1996).

However, by conducting comparative convergence analysis between a developing country, South Africa and the OECD developed economies, we are able to gain valuable insights into the income and developmental disparities that exist.

The results of the analysis show that there was a negative relationship between the growth rate over 1980-2019 and the GDP per capita in 1980 between the OECD countries. However, a contrary relationship is observed between the growth rate over the same period and the steady state GDP per capita equilibrium level. This demonstrates economic development achieved by these countries heeded within the parameters of the model. Furthermore, despite the level of technology available in each of the OECD countries in 2019, data of the collective average indicates that it is not being exploited to harness its full capability, therefore producing an output lower than its steady state equilibrium.

The opposite is observed for South Africa where its actual GDP is higher than its GDP per effective worker meaning that the level of technology available in the country is being fully exploited and applied, thereby producing an output higher than its steady state

equilibrium level. The overall economic performance of South Africa over these 39 years were significantly lower, where the OECD average GDP per capita is more than double than that of the country. Elaboration of this phenomenon is beyond the parameters of this model and requires further exploration using the appropriate application of other economic theories. In light hereof, it aided the apparent conclusion that it will take South Africa approximately 67,5 years to reach the 2019 OECD average GDP per capita.

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