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The impact of discretionary taxation on economic growth in South Africa

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THE IMPACT OF DISCRETIONARY TAXATION ON ECONOMIC GROWTH IN SOUTH AFRICA

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DECLARATION

I Makoto Tryphosa Masipa declare that this is my true work and that it was written free from intentional and unintentional misquotations and plagiarisms. All sources that were used have been properly quoted and referenced.

Signature: 

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ABSTRACT

This paper considers the impact of taxes on long run growth in the South African context for the period: 1994 to 2019. The Autoregressive Distributed Lag (ARDL) bounds test was employed to test the long run cointegrating relationship between the variables. Further, in the study, the long run and the short run models were estimated. The results from the cointegration tests show that there is a significant long run relationship between GDP growth and tax revenue. Supply-side theorists advocate for tax cuts to improve growth; however, the results investigated in this paper are contrary to those espoused by supply-side theorists. Tax revenue can potentially improve growth in South Africa if put to good use. There is a stable long run relationship with high levels of significance between GDP and total factor productivity and between GDP and labour forces. Further, the results show a positive yet insignificant relationship between GDP growth and human capital growth. In the short run, results show that there is a positive and insignificant relationship between GDP and tax revenue as well as between GDP and human capital and labour forces. Finally, the results show a significant and positive relationship between Total factor productivity and GDP.

It is recommended that adjustments in the level of government expenditure should be made to promote economic growth in South Africa (Example, invest in education and labour forces for growth).

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ABBREVIATIONS

ARDL – Autoregressive distributed lag

GDP – Gross Domestic Product

TR – Tax Revenue

HC – Human Capital

LF – Labour Forces

TFP – Total Factor Productivity

ADF – Augmented Dicker Fuller

PP – Phillips Perron

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SECTION 1

INTRODUCTION

1.1. INTRODUCTION AND BACKGROUND

Taxes are an instrument of fiscal policy (Tosun and Abizadeh, 2005), thus it's important to gain a better understanding of how taxes affect the economy especially as a means to help improve growth and sustainable development.

Since the transition to democracy in 1994, South Africa has experienced three recessions all affecting the Gross Domestic Product of the country (IDC, 2018). During these recessions, the monetary and fiscal policy were of great support to the South African economy (National treasury, 2009). In the recession that took place in 2008/2009 there were fiscal easing and the government resorted to borrowing for economic recovery which led to an increase in the budget deficit, from 1 percent in 2008/2009 to over 7 per cent of GDP in 2009/2010 (National treasury, 2020). Following the recessions that took place in the beginning of 2018 and the one that took place in the last two quarters of 2019 and 2020, the personal income tax corporate income tax were underperforming. The South African government maintains a countercyclical fiscal policy for economic stability (National treasury, 2020).

There are two fundamental demand-side channels through which fiscal policy can influence economic growth. The first, according to the standard Keynesian model, is discretionary measures, which involve the deliberate adjustment in the level of government expenditure autonomous taxes to promote growth or stabilise growth fluctuations (Blinder, 2008). The second, automatic fiscal stabilisers, which, unlike discretionary fiscal policy, respond automatically to changes in macroeconomic fluctuations and therefore can stabilise the economy without the need for active policy (Blinder, 2008).

Supply-side theorists, view taxation as distortionary and thus advocate for tax cuts to promote growth. As discussed in Gale and Samwick (2014), lower tax rates raise the after-tax reward for saving, investing, saving, and working thus positively affecting the size of the economy

There are several noteworthy empirical studies investigating the effects of taxation on economic growth, for instance the seminal contribution by Romer & Romer (2010) reveals that increases in taxes can lead to declines in the Gross Domestic Product. The findings in Perotti (2012) suggest that we can expect tax changes to have stronger effects on growth/output. Similarly, Cloyne (2013) has identified that tax cuts stimulate the economy.

This study seeks to investigate the impact of taxes on long run growth; where growth is defined as an increase in the capacity production of goods and services from one period to another in an economy (Raisove and Durcova, 2014). The question remains: tax changes have a positive or distortionary effect on the economy? Guided by the fundamentals of endogenous growth theory and the overwhelming empirical evidence to suggest a negative relationship between taxes and long-term growth e.g., Xu and Shome. P (1994); (Romer & Romer, 2010) and Ugwuanyi & Ugwunta (2015) among others, this paper aims to ascertain if such a relationship applies in the case of South Africa. More precisely, do increases in income taxes have a significant and negative relation with the long run economic growth of South Africa?

The research paper will be organised as follow: the first section will provide an introduction background, definition of concepts and the significance of the study, I will further outline the problem statement, research question, and the objective of the study. Section 2 consists of a review of the theoretical link between taxes and economic growth, as well as the empirical studies that have been conducted in this regard. This is followed by a discussion of the research methodology. Thereafter, in section 4, short and long run dynamic models will be presented and interpreted. The paper concludes with a summary and policy recommendations.

1.2. PROBLEM STATEMENT

The South African economy is considered the largest economy among others in Africa and is classified as an upper-middle-income economy. The economy witnessed steady increases in its GDP growth rates in the formative years since achieving democracy. According to a publication by Independent Development Corporation (IDC) (2018) Africa recorded an average annual growth rate of 3.3% per annual in real terms over the periods 1994-2012 with

GDP almost tripling to peak at $400 billion in 2011. Despite these favourable outcomes, this period was also marred by a severe economic downturn. Given that growth in South Africa has always been intrinsically linked to global economic performance, the financial crisis of 2007/2008, which culminated in a global recession in 2009, meant that South Africa experienced its first recession since the beginning of 1994. It resulted in job losses, deterioration of the trade balance and dramatic decreases in business confidence (Department of Research and Information, 2013). Furthermore, this period also saw a significant rise in the budget deficit increasing to 7.6 per cent of the country's GDP. This is a reasonable expectation since most governments, faced with a recession, will have the incentive to deliberately change the tax policy, either by giving tax relief or to lessen taxes on the household. The deficit reduction will result from strict monitoring of government spending and increases in taxation (National treasury, 2009).

The second recession since 1994 took place in the first and second quarter of 2018, with the economy shrinking by over 0.7% in the second quarter of 2018 because of a fall-off in activity in the manufacturing, transport, and trade industries. The country recorded its third recession in the year 2019 when its economy shrank by 1.4% in the last quarter of the year (Statistics SA, 2020) and recently, South Africa experienced severe recession during the pandemic, with over 16.4% fall in the GDP between the first and second quarter of 2020 as the coronavirus lockdown hit the country the hardest in the first two quarters (SARB, 2020). StatsSA data showed that the country experienced a great fall in the GDP than the 6.1% decline in GDP reported in 2009 during the global financial crisis.

According to a publication by the national treasury (2020), the South African government implemented tax hikes over the past few years in response to the recessions, government has increased rates of capital gains tax, personal income tax, VAT and dividends tax. Therefore, given these important developments in discretionary fiscal policy, as a response to the recession, the study seeks to better understand whether deliberate changes to taxes will affect economic growth.

1.3. RESEARCH QUESTION AND THE OBJECTIVE OF THE STUDY

1.3.1. Main question

What is the link between economic growth and fiscal policy in South Africa?

1.3.2. Objective of the study

Taking into consideration the question under this study, the main objective of the paper is to investigate the impact of tax changes on the growth rate of GDP of South Africa, to understand if discretionary changes to tax policy can impact on long-run growth.

SECTION 2

LITERATURE REVIEW

2.1. INTRODUCTION

This section of the paper will discuss theories related to the study and in addition to the theoretical literature, empirical literature will be discussed.

2.2. THEORETICAL LITERATURE

The advent of endogenous growth theory has provided an ideal framework through which the effects of taxation on economic growth could be explored. Standard endogenous growth models developed by Romer (1989a, 1990), Lucas (1990), King et al. (1988) and Jones et al. (1993) among others, declares that taxation and government expenditure will have effects on the economic growth in the short run and in the long run and that internal forces more than external forces are the driver of economic growth. Output is a function of physical capital stock and human capital, this is proposed by the endogenous growth theory. Endogenous growth models even in its simplest form, i.e., the AK Model, propagates that increases in investments in the human and physical capital, have potential to increase output (Myles, 2000). Denaux (2007) considers two factors of production necessary for production: the human capital which is obtained through education and training and physical capital. Growth in these factors of production allow for growth in production.

Growth in the long run depends on policy measures which have grave implications on competition, change, innovation, and openness (Ugwuanyi & Ugwunta, 2015). According to endogenous growth theory, growth is driven by human capital, public infrastructure, and innovation (Romer, Lucas (1990). By modelling the process through which growth is generated, these models are able to identify the effects that taxes have on economic growth (Myles, 2000).

Taxation also has supply side implications; supply-side economics is used to determine how changes in taxes affect economic activities (Lucas, 1990). High levels of taxation can affect the

incentive to invest in new technologies thus affecting output or growth. Taxes reduces the incentive to supply labour and capital (Mertens & Ravn, 2013). According to Myles (2000) taxation influences individual decision-making in that increases in personal income tax will discourage their incentive to work and will lead to individuals investing less in their education, thus resulting in reduction in the labour stock and human capital. Corporate income tax affects capital stock because it erodes profits making companies reluctant to invest. Taxes profits and capital gains and income also distort the investment channel. Property taxes affects home building investments. The endogenous growth model predicts that taxes on income and capital gains negatively affects growth and that government spending on education and operating schools and physical stock have a positively effects economic growth in the long run.

Cuts in corporate income taxes and personal income taxes lowers tax revenues on the one hand, and on the other, improves consumption, investment, and levels of employment (Personal income tax cuts) and cuts in corporate income taxes seems to only improve companies' investments (Mertens & Ravn, 2013). Lucas (1990) has estimated that eliminating capital income tax, can increase the capital stock by over 35%; increasing production capacity and as a result, boost the economy's long-run growth rate.

Feldstein (2006) using a relatively non-technical, two period life cycle model to explain that the tax on labour can be distortionary not only through reducing labour supply, but also other aspects such as the amount of human capital per worker, the effort that workers exert, the choice of occupation and location etc. These are as much a part of employee contribution to national output, as is labour hours and are equally affected by higher marginal tax rates. Using the same framework, he argues that tax on investment income is efficiency-reducing since is distorts the way consumers make decisions about future consumption even when household saving does not respond to taxes and the net rate of return. i.e., "We care about how much we consume both now and, in the future, not about how much we save to achieve that future consumption" (Feldstein, 2006, pg. 17)

2.3. EMPIRICAL LITERATURE

There are a number of studies about the impact of taxation on growth conducted for different countries in the world. The review that is to follow, will discuss empirical findings for various country groups as well as the body of literature in the case of South Africa. The seminal contribution by Romer and Romer (2010), who measure discretionary fiscal policy using the novel narrative approach (i.e., based documentation accompanying tax bills), concluded that changes in taxes have large negative effects on growth/output. The main empirical finding in their study is that a 1% increase in taxes can lead to a decline of 3% in GDP. Perotti (2012) extended the approach utilised by Romer and Romer (2010) by segregating the tax bills into main items (different types of taxes) and their sub-items. They then track starting dates and trends in taxation changes for each item. To this end, Perotti (2012) found similar responses to changes in taxes, as previously documented in Romer and Romer (2010).

A comprehensive study by Ugwuanyi and Ugwunta (2015) investigated the effects of distortionary and non-distortionary taxes on economic growth: Evidence from Sub-Saharan African countries, the authors identified that taxation and expenditure affects economic growth. Their research employed secondary data of the countries in a panel least squares. The authors found that distortionary taxes (taxes on income and property) have a negative and insignificant effect while non-distortionary taxes (reflecting indirect taxation) have an insignificant yet positive effect on the output of sub-Saharan African countries.

Existing studies in this area written in the South African context include the longitudinal study by Koch, Schoeman and Van Tonder (2005) who examine the tax structure and its effects on economics growth for the period 1960 to 2002. Through their investigation, the authors noted that that tax effects are different between developing and developed countries, they further outlined that increases in taxes reduces economic activity thus negatively affecting economic growth and that if taxes are put to good use, they could positively affect economic growth in the long run (for example when revenue received in the form of taxes is invested in public health and education). A noteworthy observation is that the authors could not reach an unequivocal conclusion as to whether increasing taxes or decreasing taxes is beneficial. In order to isolate the effects of the tax policies and help them reach conclusive results, the authors included, as controls, other possible causes of changes in economic growth. To this end, the results yield an overall finding that decreases in taxation increases economic performance of a country.

Dladla and Hlalefang (2018) undertake a similar investigation of the impact of taxation on economic growth in South Africa, using annual data, from 1981 to 2016 sourced from the South African Reserve Bank and the World Bank for their investigation. The authors outline that there have been many studies written on the impact of taxes on economic growth with most of these studies finding a negative relationship between the two as increases in taxes affects incentive to work thus decreasing productivity. They have further noted that high tax rates discourage household savings and investments and as a result affect economic growth negatively. Because of the increases in tax revenue and economic growth post-apartheid in South Africa, the authors saw it fit to try and find out if there is a relationship between economic growth and taxation in South Africa. Using an ARDL approach to find the relation among the variables, they conclude that taxes negatively affect economic growth in the long run and short run.

Other noteworthy contributions in the context of South African include Jooste, Liu & Naraidoo (2013) who analysed the effects of fiscal policy shocks in the South African economy. The study used different methodologies to show that fiscal policy has been effective in stimulating consumption and Output in South Africa. The results from the analysis first, indicates that an increase in government spending positively impacts gross domestic product in the short run; second, the impact of government spending on gross domestic product is insignificant in the long run and lastly, increases in taxation decreases gross domestic product in short run, and on the other hand, have negligible effects over longer horizons. Likewise, Saibu (2015) undertake to estimate the optimal tax rate and economic growth. The study focused on Nigeria and South Africa, to which end they found that a significant nonlinear relationship is found in the case of Nigeria while nonlinearity hypothesis for the effects of taxation in the case of South Africa is rejected while Suggesting that the tax rate that maximises growth should be in the range of 15% for South Africa and 30% for Nigeria. The authors' results show that higher taxes are associated with reduced economic growth.

As stated in the problem statement, South Africa experienced high levels of growth since the beginning of its democracy, with the rate of growth changing over the years and currently, there has been decreases in the country's gross domestic product. This paper aims to add to the existing body of literature; however, the study will be using as a guide an extended endogenous growth model adapted from Denaux (2005). Given the current economic

conditions coupled with the changing trends in taxes collected have over the years (surpassing the trillion levels), requires a deeper understanding of the long-run impact of taxes in growth for a country like South Africa. The study improves on exiting literature by including tax revenue composing of different types of taxes thus allowing a deeper understanding of the different channels through which taxes can impact on long-run growth rates.

SECTION 3

RESEARCH METHODOLOGY

3.1. INTRODUCTION

This section of the paper will discuss the research methodology that is to be applied. It begins by specifying the model for estimation, the data that will be utilised, the ARDL model followed by a brief discussion of the various diagnostic testing, i.e., unit root test, bounds tests, causality etc. Based on the outcome of these preliminary tests that will be specified, and the appropriate econometric approach will be discussed.

3.2. MODEL FOR ESTIMATION

The model used in this study is guided by endogenous growth theory and loosely adapted from the specification first discussed in Denaux (2007), who utilises a two-sector endogenous growth model to analyse the effects of fiscal policy on output.

The model is specified to estimate the relationship between the dependent variable, i.e., growth rate of gross domestic product as a function explained by taxes on personal income tax, corporate income tax and profits and capital gains (each measured as a percentage of total revenue).

The model will also include, as way of control variables, a set of independent variables to capture changes in human capital, changes in labour forces (population growth is used as a proxy) and total factor productivity. The empirical model is specified as:

$GDP_t = \beta_0 + \beta_1 TR_t + \beta_2 \Delta HC_t + \beta_3 \Delta LF_t + \beta_4 TFP_t$

Where:

GDP_t= Gross Domestic Product

$\beta_1 TR_t$ = Tax revenue

$\beta_2 \Delta HC_t$ = human capital

$\beta_3 \Delta LF_t$ = labour forces

$\beta_4 TFP_t$ = Total factor productivity

$\beta_1, \beta_2, \beta_3, \beta_4$= Slope coefficients

3.3. DATA COLLECTION

The study will use secondary time series data in the form of annual data from 1994 to 2019. Data was predominately sourced from the South African Reserve Bank- Online statistical query as well as the Penn World Table: version 10.0 database. More specifically, GDP growth and the tax revenue as a composite of different tax types, have been obtained from the South African Reserve bank. In addition, the control variables that complete the endogenous growth theory specification, i.e. population growth used as a proxy for labour force, the human capital index as a measure of human capital produced through schooling and total factor productivity, have all been obtained from the Penn World Table.

3.4. ESTIMATION TECHNIQUES

The ARDL captures the cointegration between set of variables, simultaneously for the long and short run. The model of ARDL employed in the study was adopted from Pesaran et al. (2001).

3.5. THE ARDL MODEL

$$\Delta GDP_t = \beta_0 + \sum_{i-1}^{p} \beta_1 \Delta GDP_{t-i} + \sum_{i-1}^{p} \beta_2 \Delta TR_{t-i} + \sum_{i-1}^{p} \beta_3 \Delta HC_{t-i} + \sum_{i-1}^{p} \beta_4 \Delta LF_{t-i} + \sum_{i-1}^{p} \beta_4 \Delta TFP_{t-i} + \delta_1 GDP_{t-1} + \delta_2 TR_{t-1} + \delta_3 HC_{t-1} + \delta_4 LF_{t-1} + \delta_5 TFP_{t-1} + \varphi EC_{t-1}$$

β_0 in the model represents the constant and Δ in the model denotes the first difference operator in the ARDL model. The short-run relationship is shown by $\beta_1 - \beta_5$ coefficients. The long run relationship in the model is shown by $\delta_1 - \delta_5$ coefficients., EC in the model denotes the residual obtained from estimated cointegration in equation and φ represents the speed of adjustments (Sisimogang, Mah, & Saah, 2016).

3.6. DIAGNOSTIC TESTS

a) Unit Root Test

The unit root test is the first step to check the stationarity of the variables. For the variables that are not stationary based on the ADF (Augmented Dickey-Fuller) test will be differenced

to make them stationary. If after the unit root, we find that some are stationary, and some require differencing then we will move to ARDL which allows us to have mixed variables. Alternatively, the OLS or Johansen can be used. This is done to ensure that regression tests are reliable.

b) Bounds Test

The bounds testing method as developed by Pesaran et al. (2001) is for testing cointegration in the ARDL. The test is largely based on the value of the F-statistic to investigate if a long-run relationship exists. It rests on the premise that the computed F-statistic must exceed the upper critical bound value in order to reject the null hypothesis (Ho).If that is the case, we conclude that there is cointegration and that there is a long-run relationship. Conversely, if the computed F-Statistic falls below the lower critical bound value, the null hypothesis cannot be rejected. Finally, if the resulting F-Statistic falls between the respective lower and upper bounds, the results are said to be inconclusive.

c) Causality

The granger-causality test is used to test for causality in the study. If the probability value is significant at either 10%, 5% or 1% we reject the null hypothesis at that particular level of significance.

3.7. ETHICAL CONSIDERATIONS

The study employs secondary data from South African Reserve Bank and Penn World Tables. The data collected is free from ethical issues. Nonetheless, all the sources used were appropriately acknowledged.

SECTION 4

EMPIRICAL RESULTS AND DISCUSSION

4.1. INTRODUCTION

In this section, the study outlines the findings from both the diagnostic as well as the formal parametric testing conducted. Standard econometric models were utilised to yield the results presented below. We begin by discussing the results from the ADF (Augmented Dickey Fuller) and PP(Phillips Perron) test for the presence of unit roots. Thereafter we present a detailed discourse on the co-integration analysis using the bounds test, and the subsequent causality test. The study further discusses the long run and short run cointegration and lastly the diagnostic and stability tests. Section four presents both the analysis and discussion of the findings.

4.2. UNIT ROOT TEST RESULTS

Table 1 summaries the results of the unit root test from the Augmented Dickey-Fuller (ADF) and Phillips-Peron tests. The ADF and PP tests were performed at first differenced I (1), as well as level I (0), as presented in Table 1. The t-statistics for all the variables (GDP, Tax revenue, Human capital, Labour forces and Total factor productivity) are greater than the critical values at 1%, 5% and 10% levels of significance, respectively for both ADF and PP tests. Detailed results of the unit root tests are presented in the appendix section. The results of the ADF confirm that all variables are stationary, with GDP and human capital stationary at level, and tax revenue, labour forces and total factor productivity stationary at first difference.

Table 1: ADF test result

	Levels		First difference	
Variable	**ADF**	**PP**	**ADF**	**PP**
GDP	-4.76*	-4.03*	-2.31	-2.19
TR	-2.40	-2.56	-3.30**	-3.11**
HC	-4.39*	-3.67*	-2.06	-2.06
LF	-1.68	-1.15	-4.03*	-3.40**
TFP	-0.22	-0.50	-4.40*	-4.44*

Values marked with a * represent stationary variables at 1% significance level, and ** represent stationary at 5% significance level and *** represent stationary variable at 10%.

ARDL RESULTS

4.3. COINTEGRATION

The results of ARDL framework, as described in section three of the paper are presented in the two tables below. The tables 2 and 3 below presents the results of the bounds testing approach.

Table 2: Bounds test

EQUATION	F-STATISTIC	Lower bound I(0) at 5%	Lower bound I(1) at 5%	Outcome
GDP	5.6343***	2.56	3.49	**COINTEGRATION**

Table 3: Critical Value Bounds

Significance	I (0) Bound	I (1) Bound
10%	2.2	3.09
5%	2.56	3.49
1%	3.29	4.37

Based on the ARDL bound estimation, the null hypothesis of no co-integration can be rejected in favour of the alternate hypothesis that there exists a long-run relationship between GDP growth and taxation. The calculated F-statistic value of 5.6343 is greater than the upper

bound critical value of 3.49 and the lower bound critical value of 2.56 at 5% level of significance, suggesting that the variables are cointegrated.

Standard endogenous growth models developed by Romer (1989a, 1990), Lucas (1990), King et al. (1988) and Jones et al. (1993) among others, declares that taxation and government expenditure will have both long run and short run effects on the economic growth. The bounds testing approach therefore provides evidence that there is a long-run relationship between the variables in the GDP model.

4.4. CASUALITY

The error correction model will be assessed using the granger causality test presented in table 4 below.

Table 4: Granger test results

Null hypothesis	F-Statistic	Probability	Test	Result
TR does not granger cause GDP	0.80706	0.4609	DNR	
HC does not granger cause GDP	2.13203	0.1461	DNR	
LF does not granger cause GDP	1.98757	0.1645	DNR	
TFP does not granger cause GDP	1.68286	0.2124	DNR	
GDP does not granger cause TR	5.36634	0.0142	REJECT	GDP causes Tax revenue
GDP does not granger cause HC	4.32634	0.0283	REJECT	GDP causes Human capital
GDP does not granger cause LF	111.985	3.11	DNR	
GDP does not granger cause TFP	3.61410	0.0468	REJECT	GDP causes Total factor productivity

Note: DNR- Do not reject

From table 4 above, we reject the null hypothesis that Gross Domestic Product (GDP) does not granger cause Tax revenue, human capital, and total factor productivity. This means that increases in Tax revenue, Human capital and Total factor productivity are driven by economic growth. Based on the above results, we can conclude that Tax revenue, Human capital and Total factor productivity are components of economic growth.

4.5. REGRESSION RESULTS

4.5.1. LONG-RUN RELATIONSHIP ANALYSIS

Table 5 below shows the long-run elasticities of the estimated model.

Table 5: Estimated long-run analysis results

Variable	Coefficient	Probability
Tax revenue	0.459676	0.0000
Human Capital	0.014244	0.9014
Labour Forces	3.019682	0.0015
Total Factor Productivity	0.487682	0.0000
C	-1.960587	0.0735

Tax revenue indicates a positive long-run and statistically significant relationship and since the government revenue mainly comes from taxes, particularly income taxes, increases in taxation will increase the country's revenue, thus positively affecting economic growth in South Africa. There is a positive and insignificant relationship between human capital and economic growth. These results are concurred to the *a priori* expectation as espoused in Romer (1989a, 1990), Lucas (1990) and Denaux (2007) amongst others, which consider human capital as a factor of production, such that growth in human capital will lead to greater long-run growth. Total factor productivity indicates a positive and significant long-run relationship. Lastly, as expected, the coefficient on the labour force, labour forces indicates a positive long-run effect on growth and is statistically significant at 5% level of significance. Increases in the labour force as a factor of production will lead to greater full-employment growth.

4.5.2. SHORT-RUN RELATIONSHIP ANALYSIS

Table 6: Estimated short-run analysis results

Variable	Coefficient	Probability
Tax revenue	0.098340	0.1881
Human Capital	0.020408	0.9430
Labour Forces	2.583986	0.3525
Total Factor Productivity	0.052111	0.0091
CoinEQ(-1)	-0.467104	0.0092

The results of the short run analysis in the above table, Table 6 indicate that the coefficient of the ECM (-0.467104) is statistically significant and bearing the theoretically expected negative sign. The coefficient shows the speed of adjustment of around 47% which implies that the system will be able to revert back from the short run to the long run equilibrium at the rate.

4.6. DIAGNOSTIC AND STABILITY TEST

4.6.1. DIAGNOSTIC TESTS

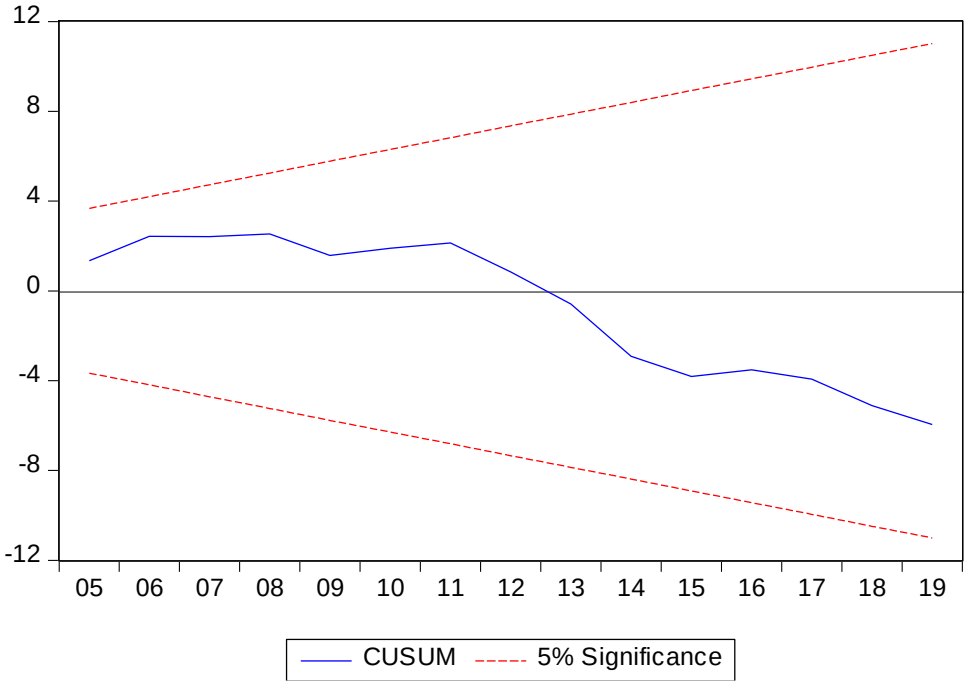
Table 7: Summary of diagnostic test results

Testing Procedure	Ho	T-Statistic	P – Value	CONCLUSION
Jarque-Bera normality test	Residuals are normally distributed	0.115678	0.943802	Do not reject Ho given that the P-Value (0.94) is greater than L.O.S (0.05) implies that residuals are normally distributed.
Breusch-Godfrey Serial correlation test	No Serial correlation	6.587949	0.1175	Do not reject null hypothesis (Ho) as PV > L.O.S at 5%, therefore there is No serial correlation
Harvey Test	No Heteroscedasticity	13.49954	0.0696	Do not reject Ho given that PV (0.07) > L.O.S (0.05) showing that there is no heteroscedasticity

Table 7 above shows the residual diagnostics of the Gross Domestic Product model. Detailed results of the diagnostic tests are presented in the appendix section. The residuals are normally distributed in the model, this is evident by the non-rejection of the null hypothesis using the Jarque-Bera. The study uses the Breusch-Godfrey test to test for serial correlation, from the results in table 7, we can conclude that there is no serial correlation in the model; the p-value is insignificant. To test for heteroscedasticity, the study uses the Harvey test and there is no heteroscedasticity.

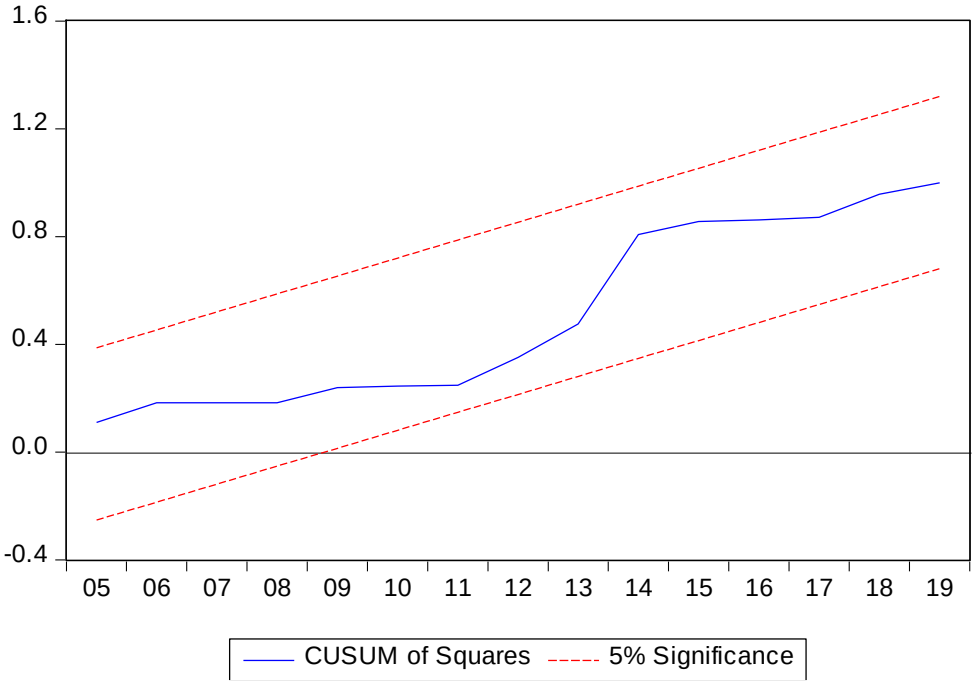
4.6.2. STABILITY TESTS

Figure A: Cusum Test Results



In figure A above, the CUSUM test was conducted, and the results show that the cumulative sum of squares falls within the 5% significance lines suggesting that the model is stable and correctly specified.

Figure B: Cusum of Squares Test Results



In figure B the CUSUM of Squares Test was conducted, and the results show that the cumulative sum of squares fall within the 5% significance lines also suggesting that the residual variance is stable. The results obtained indicates that the coefficients are stable.

SECTION 5

CONCLUSION AND RECOMMENDATIONS

The main objective of this study was to investigate the impact of taxes on long run growth in the South African context for the period: 1994 to 2019. Employing the ARDL approach to co-integration, the study finds that the short-run significance of the government tax revenue and the endogenous growth theory variables to economic growth are different from the long-run significance. However, there exists positive relationship between economic growth and taxation and growth theory variables in the short run and long run. Tax revenue has an insignificant impact on economic growth in the short run but have a significant impact when the long-run relationship is investigated. The results further show that total factor productivity is positively and significantly related to growth in the short-run and in the long-run. The results show a positive and insignificant relationship between changes in human capital and growth in the long run and in the short run. Lastly, the results show a positive and insignificant relationship between labour forces and economic growth in the short run and a positive and significant relationship in the long run.

Most studies show a negative relationship between growth and taxation, in this study we have found that taxation positively affects economic growth and has a positive impact but doesn't have much impact on growth in short run. South African government collects most of its revenue from taxation and yet our economy is still in shambles. If taxes are put to good use, they could have a great impact on economic growth (Koch, Schoeman and Van Tonder, 2005). The South African government should change its budget allocations to improve its economic growth. In the revision of the budget allocation, the government should consider investing revenue received into projects that are beneficial to the economy. Given the current global volatility and the recent recession that South Africa has experienced, which has resulted in deteriorating growth leading to unprecedented unemployment rates, it is clear that the government has been spending far more of its tax revenue on social security, and debt reduction than on productive expenditure. Adjustments in the level of government expenditure should be made to promote growth. Tax revenue, if directed to more investments in education and labour forces will lead to a greater long-run growth.

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APPENDIX A

Null Hypothesis: GDP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.759647	0.0009
Test critical values:	1% level	-3.724070	
	5% level	-2.986225	
	10% level	-2.632604	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GDP)
Method: Least Squares
Date: 09/27/22 Time: 09:03
Sample (adjusted): 1995 2019
Included observations: 25 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP(-1)	-0.028190	0.005923	-4.759647	0.0001
C	0.215761	0.036987	5.833355	0.0000

R-squared	0.496213	Mean dependent var	0.039921
Adjusted R-squared	0.474310	S.D. dependent var	0.012375
S.E. of regression	0.008972	Akaike info criterion	-6.512762
Sum squared resid	0.001851	Schwarz criterion	-6.415252
Log likelihood	83.40952	Hannan-Quinn criter.	-6.485717
F-statistic	22.65424	Durbin-Watson stat	1.415648
Prob(F-statistic)	0.000085		

Null Hypothesis: GDP has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.031597	0.0049
Test critical values:	1% level	-3.724070	
	5% level	-2.986225	
	10% level	-2.632604	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	7.41E-05
HAC corrected variance (Bartlett kernel)	0.000104

Phillips-Perron Test Equation
Dependent Variable: D(GDP)
Method: Least Squares
Date: 09/27/22 Time: 09:07

Sample (adjusted): 1995 2019
Included observations: 25 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP(-1)	-0.028190	0.005923	-4.759647	0.0001
C	0.215761	0.036987	5.833355	0.0000

R-squared	0.496213	Mean dependent var	0.039921
Adjusted R-squared	0.474310	S.D. dependent var	0.012375
S.E. of regression	0.008972	Akaike info criterion	-6.512762
Sum squared resid	0.001851	Schwarz criterion	-6.415252
Log likelihood	83.40952	Hannan-Quinn criter.	-6.485717
F-statistic	22.65424	Durbin-Watson stat	1.415648
Prob(F-statistic)	0.000085		

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.306384	0.1781
Test critical values:	1% level	-3.737853	
	5% level	-2.991878	
	10% level	-2.635542	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GDP,2)
Method: Least Squares
Date: 09/27/22 Time: 09:09
Sample (adjusted): 1996 2019
Included observations: 24 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	-0.400731	0.173749	-2.306384	0.0309
C	0.014745	0.007365	2.002074	0.0578

R-squared	0.194712	Mean dependent var	-0.001587
Adjusted R-squared	0.158108	S.D. dependent var	0.010810
S.E. of regression	0.009918	Akaike info criterion	-6.309211
Sum squared resid	0.002164	Schwarz criterion	-6.211040
Log likelihood	77.71053	Hannan-Quinn criter.	-6.283166
F-statistic	5.319406	Durbin-Watson stat	2.234619
Prob(F-statistic)	0.030889		

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.194040	0.2133
Test critical values:	1% level	-3.737853	

	5% level	-2.991878
	10% level	-2.635542

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	9.02E-05
HAC corrected variance (Bartlett kernel)	7.84E-05

Phillips-Perron Test Equation
Dependent Variable: D(GDP,2)
Method: Least Squares
Date: 09/27/22 Time: 09:10
Sample (adjusted): 1996 2019
Included observations: 24 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	-0.400731	0.173749	-2.306384	0.0309
C	0.014745	0.007365	2.002074	0.0578

R-squared	0.194712	Mean dependent var	-0.001587
Adjusted R-squared	0.158108	S.D. dependent var	0.010810
S.E. of regression	0.009918	Akaike info criterion	-6.309211
Sum squared resid	0.002164	Schwarz criterion	-6.211040
Log likelihood	77.71053	Hannan-Quinn criter.	-6.283166
F-statistic	5.319406	Durbin-Watson stat	2.234619
Prob(F-statistic)	0.030889		

Null Hypothesis: TR has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.396911	0.1526
Test critical values:	1% level	-3.724070	
	5% level	-2.986225	
	10% level	-2.632604	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(TR)
Method: Least Squares
Date: 09/27/22 Time: 09:12
Sample (adjusted): 1995 2019
Included observations: 25 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TR(-1)	-0.032981	0.013760	-2.396911	0.0251
C	0.222249	0.074138	2.997795	0.0064

R-squared	0.199866	Mean dependent var	0.044892
Adjusted R-squared	0.165077	S.D. dependent var	0.025222
S.E. of regression	0.023047	Akaike info criterion	-4.625964

Sum squared resid	0.012217	Schwarz criterion	-4.528454
Log likelihood	59.82455	Hannan-Quinn criter.	-4.598918
F-statistic	5.745182	Durbin-Watson stat	1.625657
Prob(F-statistic)	0.025052		

Null Hypothesis: TR has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.547008	0.1171
Test critical values:	1% level	-3.724070	
	5% level	-2.986225	
	10% level	-2.632604	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000489
HAC corrected variance (Bartlett kernel)	0.000425

Phillips-Perron Test Equation
Dependent Variable: D(TR)
Method: Least Squares
Date: 09/27/22 Time: 09:13
Sample (adjusted): 1995 2019
Included observations: 25 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TR(-1)	-0.032981	0.013760	-2.396911	0.0251
C	0.222249	0.074138	2.997795	0.0064

R-squared	0.199866	Mean dependent var	0.044892
Adjusted R-squared	0.165077	S.D. dependent var	0.025222
S.E. of regression	0.023047	Akaike info criterion	-4.625964
Sum squared resid	0.012217	Schwarz criterion	-4.528454
Log likelihood	59.82455	Hannan-Quinn criter.	-4.598918
F-statistic	5.745182	Durbin-Watson stat	1.625657
Prob(F-statistic)	0.025052		

Null Hypothesis: D(TR) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.304012	0.0261
Test critical values:	1% level	-3.737853	
	5% level	-2.991878	
	10% level	-2.635542	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(TR,2)
Method: Least Squares
Date: 09/27/22 Time: 09:14
Sample (adjusted): 1996 2019
Included observations: 24 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(TR(-1))	-0.684700	0.207233	-3.304012	0.0032
C	0.029923	0.010812	2.767443	0.0112

R-squared	0.331642	Mean dependent var	-0.001589
Adjusted R-squared	0.301262	S.D. dependent var	0.029854
S.E. of regression	0.024955	Akaike info criterion	-4.463824
Sum squared resid	0.013701	Schwarz criterion	-4.365653
Log likelihood	55.56589	Hannan-Quinn criter.	-4.437780
F-statistic	10.91650	Durbin-Watson stat	1.784552
Prob(F-statistic)	0.003231		

Null Hypothesis: D(TR) has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.105072	0.0396
Test critical values:	1% level	-3.737853	
	5% level	-2.991878	
	10% level	-2.635542	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000571
HAC corrected variance (Bartlett kernel)	0.000408

Phillips-Perron Test Equation
Dependent Variable: D(TR,2)
Method: Least Squares
Date: 09/27/22 Time: 09:18
Sample (adjusted): 1996 2019
Included observations: 24 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(TR(-1))	-0.684700	0.207233	-3.304012	0.0032
C	0.029923	0.010812	2.767443	0.0112

R-squared	0.331642	Mean dependent var	-0.001589
Adjusted R-squared	0.301262	S.D. dependent var	0.029854
S.E. of regression	0.024955	Akaike info criterion	-4.463824
Sum squared resid	0.013701	Schwarz criterion	-4.365653
Log likelihood	55.56589	Hannan-Quinn criter.	-4.437780
F-statistic	10.91650	Durbin-Watson stat	1.784552
Prob(F-statistic)	0.003231		

Null Hypothesis: LF has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.154212	0.6774
Test critical values:	1% level	-3.724070	
	5% level	-2.986225	
	10% level	-2.632604	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	7.61E-07
HAC corrected variance (Bartlett kernel)	2.25E-06

Phillips-Perron Test Equation
Dependent Variable: D(LF)
Method: Least Squares
Date: 09/27/22 Time: 11:50
Sample (adjusted): 1995 2019
Included observations: 25 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LF(-1)	-0.007731	0.004097	-1.886953	0.0719
C	0.019420	0.006914	2.808763	0.0100

R-squared	0.134055	Mean dependent var	0.006378
Adjusted R-squared	0.096406	S.D. dependent var	0.000957
S.E. of regression	0.000910	Akaike info criterion	-11.09044
Sum squared resid	1.90E-05	Schwarz criterion	-10.99293
Log likelihood	140.6305	Hannan-Quinn criter.	-11.06340
F-statistic	3.560591	Durbin-Watson stat	0.137620
Prob(F-statistic)	0.071853		

Null Hypothesis: D(LF) has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.034849	0.0062
Test critical values:	1% level	-3.808546	
	5% level	-3.020686	
	10% level	-2.650413	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LF,2)
Method: Least Squares

Date: 09/27/22 Time: 11:51
Sample (adjusted): 2000 2019
Included observations: 20 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LF(-1))	-0.068515	0.016981	-4.034849	0.0012
D(LF(-1),2)	1.921619	0.170942	11.24132	0.0000
D(LF(-2),2)	-1.831579	0.346109	-5.291916	0.0001
D(LF(-3),2)	1.160119	0.326247	3.555957	0.0032
D(LF(-4),2)	-0.318820	0.135634	-2.350582	0.0339
C	0.000418	0.000105	3.980627	0.0014

R-squared	0.987364	Mean dependent var	-3.80E-05
Adjusted R-squared	0.982851	S.D. dependent var	0.000227
S.E. of regression	2.97E-05	Akaike info criterion	-17.76751
Sum squared resid	1.23E-08	Schwarz criterion	-17.46879
Log likelihood	183.6751	Hannan-Quinn criter.	-17.70919
F-statistic	218.7880	Durbin-Watson stat	2.116309
Prob(F-statistic)	0.000000		

Null Hypothesis: D(LF) has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.399169	0.0212
Test critical values:	1% level	-3.737853	
	5% level	-2.991878	
	10% level	-2.635542	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	4.95E-08
HAC corrected variance (Bartlett kernel)	1.67E-07

Phillips-Perron Test Equation
Dependent Variable: D(LF,2)
Method: Least Squares
Date: 09/27/22 Time: 11:53
Sample (adjusted): 1996 2019
Included observations: 24 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LF(-1))	-0.244273	0.050110	-4.874758	0.0001
C	0.001418	0.000324	4.370664	0.0002

R-squared	0.519265	Mean dependent var	-0.000147
Adjusted R-squared	0.497414	S.D. dependent var	0.000328
S.E. of regression	0.000232	Akaike info criterion	-13.81600
Sum squared resid	1.19E-06	Schwarz criterion	-13.71783
Log likelihood	167.7920	Hannan-Quinn criter.	-13.78996
F-statistic	23.76327	Durbin-Watson stat	0.134105
Prob(F-statistic)	0.000071		

Null Hypothesis: TFP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.223953	0.9231
Test critical values:	1% level	-3.724070	
	5% level	-2.986225	
	10% level	-2.632604	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(TFP)
Method: Least Squares
Date: 09/27/22 Time: 11:58
Sample (adjusted): 1995 2019
Included observations: 25 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TFP(-1)	-0.022800	0.101807	-0.223953	0.8248
C	0.021757	0.108466	0.200586	0.8428

R-squared	0.002176	Mean dependent var	-0.002516
Adjusted R-squared	-0.041208	S.D. dependent var	0.020655
S.E. of regression	0.021076	Akaike info criterion	-4.804742
Sum squared resid	0.010217	Schwarz criterion	-4.707232
Log likelihood	62.05927	Hannan-Quinn criter.	-4.777697
F-statistic	0.050155	Durbin-Watson stat	1.825772
Prob(F-statistic)	0.824771		

Null Hypothesis: TFP has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.501758	0.8751
Test critical values:	1% level	-3.724070	
	5% level	-2.986225	
	10% level	-2.632604	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000409
HAC corrected variance (Bartlett kernel)	0.000524

Phillips-Perron Test Equation
Dependent Variable: D(TFP)
Method: Least Squares
Date: 09/27/22 Time: 11:59
Sample (adjusted): 1995 2019

Included observations: 25 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TFP(-1)	-0.022800	0.101807	-0.223953	0.8248
C	0.021757	0.108466	0.200586	0.8428

R-squared	0.002176	Mean dependent var	-0.002516
Adjusted R-squared	-0.041208	S.D. dependent var	0.020655
S.E. of regression	0.021076	Akaike info criterion	-4.804742
Sum squared resid	0.010217	Schwarz criterion	-4.707232
Log likelihood	62.05927	Hannan-Quinn criter.	-4.777697
F-statistic	0.050155	Durbin-Watson stat	1.825772
Prob(F-statistic)	0.824771		

Null Hypothesis: D(TFP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.400535	0.0022
Test critical values:	1% level	-3.737853	
	5% level	-2.991878	
	10% level	-2.635542	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(TFP,2)
Method: Least Squares
Date: 09/27/22 Time: 12:00
Sample (adjusted): 1996 2019
Included observations: 24 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(TFP(-1))	-0.939882	0.213583	-4.400535	0.0002
C	-0.002718	0.004404	-0.617261	0.5434

R-squared	0.468146	Mean dependent var	-0.000801
Adjusted R-squared	0.443970	S.D. dependent var	0.028790
S.E. of regression	0.021468	Akaike info criterion	-4.764868
Sum squared resid	0.010139	Schwarz criterion	-4.666697
Log likelihood	59.17841	Hannan-Quinn criter.	-4.738823
F-statistic	19.36471	Durbin-Watson stat	2.018164
Prob(F-statistic)	0.000227		

Null Hypothesis: D(TFP) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.440048	0.0020
Test critical values:	1% level	-3.737853	
	5% level	-2.991878	

	10% level	-2.635542

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000422
HAC corrected variance (Bartlett kernel)	0.000478

Phillips-Perron Test Equation
Dependent Variable: D(TFP,2)
Method: Least Squares
Date: 09/27/22 Time: 12:01
Sample (adjusted): 1996 2019
Included observations: 24 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(TFP(-1))	-0.939882	0.213583	-4.400535	0.0002
C	-0.002718	0.004404	-0.617261	0.5434

R-squared	0.468146	Mean dependent var	-0.000801
Adjusted R-squared	0.443970	S.D. dependent var	0.028790
S.E. of regression	0.021468	Akaike info criterion	-4.764868
Sum squared resid	0.010139	Schwarz criterion	-4.666697
Log likelihood	59.17841	Hannan-Quinn criter.	-4.738823
F-statistic	19.36471	Durbin-Watson stat	2.018164
Prob(F-statistic)	0.000227		

Null Hypothesis: HC has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=0)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.387812	0.0097
Test critical values:	1% level	-4.374307	
	5% level	-3.603202	
	10% level	-3.238054	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(HC)
Method: Least Squares
Date: 09/27/22 Time: 12:25
Sample (adjusted): 1995 2019
Included observations: 25 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HC(-1)	-0.134177	0.030579	-4.387812	0.0002
C	0.269734	0.056836	4.745851	0.0001
@TREND("1994")	0.006445	0.001184	5.444085	0.0000

R-squared	0.826357	Mean dependent var	0.037239
Adjusted R-squared	0.810572	S.D. dependent var	0.011530
S.E. of regression	0.005018	Akaike info criterion	-7.639341

Sum squared resid	0.000554	Schwarz criterion	-7.493076
Log likelihood	98.49177	Hannan-Quinn criter.	-7.598774
F-statistic	52.34846	Durbin-Watson stat	1.096175
Prob(F-statistic)	0.000000		

Null Hypothesis: HC has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.670732	0.0437
Test critical values:	1% level	-4.374307	
	5% level	-3.603202	
	10% level	-3.238054	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	2.22E-05
HAC corrected variance (Bartlett kernel)	3.46E-05

Phillips-Perron Test Equation
Dependent Variable: D(HC)
Method: Least Squares
Date: 09/27/22 Time: 12:26
Sample (adjusted): 1995 2019
Included observations: 25 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HC(-1)	-0.134177	0.030579	-4.387812	0.0002
C	0.269734	0.056836	4.745851	0.0001
@TREND("1994")	0.006445	0.001184	5.444085	0.0000

R-squared	0.826357	Mean dependent var	0.037239
Adjusted R-squared	0.810572	S.D. dependent var	0.011530
S.E. of regression	0.005018	Akaike info criterion	-7.639341
Sum squared resid	0.000554	Schwarz criterion	-7.493076
Log likelihood	98.49177	Hannan-Quinn criter.	-7.598774
F-statistic	52.34846	Durbin-Watson stat	1.096175
Prob(F-statistic)	0.000000		

Null Hypothesis: D(HC) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=0)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.059164	0.5411
Test critical values:	1% level	-4.394309	
	5% level	-3.612199	
	10% level	-3.243079	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(HC,2)
Method: Least Squares
Date: 09/27/22 Time: 12:27
Sample (adjusted): 1996 2019
Included observations: 24 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(HC(-1))	-0.328966	0.159757	-2.059164	0.0521
C	0.008527	0.003808	2.239509	0.0361
@TREND("1994")	0.000364	0.000258	1.407716	0.1738

R-squared	0.174434	Mean dependent var	0.001368
Adjusted R-squared	0.095809	S.D. dependent var	0.005401
S.E. of regression	0.005136	Akaike info criterion	-7.588608
Sum squared resid	0.000554	Schwarz criterion	-7.441351
Log likelihood	94.06329	Hannan-Quinn criter.	-7.549540
F-statistic	2.218549	Durbin-Watson stat	2.065113
Prob(F-statistic)	0.133627		

Null Hypothesis: D(HC) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.059164	0.5411
Test critical values:	1% level	-4.394309	
	5% level	-3.612199	
	10% level	-3.243079	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	2.31E-05
HAC corrected variance (Bartlett kernel)	2.31E-05

Phillips-Perron Test Equation
Dependent Variable: D(HC,2)
Method: Least Squares
Date: 09/27/22 Time: 12:28
Sample (adjusted): 1996 2019
Included observations: 24 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(HC(-1))	-0.328966	0.159757	-2.059164	0.0521
C	0.008527	0.003808	2.239509	0.0361
@TREND("1994")	0.000364	0.000258	1.407716	0.1738

R-squared	0.174434	Mean dependent var	0.001368
Adjusted R-squared	0.095809	S.D. dependent var	0.005401
S.E. of regression	0.005136	Akaike info criterion	-7.588608
Sum squared resid	0.000554	Schwarz criterion	-7.441351
Log likelihood	94.06329	Hannan-Quinn criter.	-7.549540
F-statistic	2.218549	Durbin-Watson stat	2.065113

Prob(F-statistic)	0.133627

APPENDIX B

Bounds test results

ARDL Bounds Test
Date: 09/25/22 Time: 19:55
Sample: 1995 2019
Included observations: 25
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	5.634333	4

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	2.2	3.09
5%	2.56	3.49
2.5%	2.88	3.87
1%	3.29	4.37

Test Equation:
Dependent Variable: D(GDP)
Method: Least Squares
Date: 09/25/22 Time: 19:55
Sample: 1995 2019
Included observations: 25

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(TR)	0.097020	0.093233	1.040619	0.3135
D(HC)	0.756336	0.441207	1.714245	0.1058
D(LF)	5.533090	6.204157	0.891836	0.3857
C	-0.530002	1.268837	-0.417707	0.6817
TR(-1)	0.195637	0.092070	2.124871	0.0495
HC(-1)	-0.055244	0.119568	-0.462030	0.6503
LF(-1)	0.971248	1.169253	0.830657	0.4184
TFP(-1)	0.120463	0.124679	0.966184	0.3483
GDP(-1)	-0.350530	0.185923	-1.885357	0.0777

R-squared	0.715603	Mean dependent var	0.039921
Adjusted R-squared	0.573405	S.D. dependent var	0.012375
S.E. of regression	0.008082	Akaike info criterion	-6.524544
Sum squared resid	0.001045	Schwarz criterion	-6.085749
Log likelihood	90.55680	Hannan-Quinn criter.	-6.402841
F-statistic	5.032426	Durbin-Watson stat	2.405538
Prob(F-statistic)	0.002959		

APPENDIX C

Pairwise Granger Causality Tests
Date: 09/25/22 Time: 20:10
Sample: 1994 2019
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
TR does not Granger Cause GDP	24	0.80706	0.4609
GDP does not Granger Cause TR		5.36634	0.0142
HC does not Granger Cause GDP	24	2.13203	0.1461
GDP does not Granger Cause HC		4.32634	0.0283
LF does not Granger Cause GDP	24	1.98757	0.1645
GDP does not Granger Cause LF		111.985	3.E-11
TFP does not Granger Cause GDP	24	1.68286	0.2124
GDP does not Granger Cause TFP		3.61410	0.0468
HC does not Granger Cause TR	24	0.36711	0.6975
TR does not Granger Cause HC		2.97572	0.0751
LF does not Granger Cause TR	24	0.56592	0.5771
TR does not Granger Cause LF		21.4878	1.E-05
TFP does not Granger Cause TR	24	0.78008	0.4725
TR does not Granger Cause TFP		7.44786	0.0041
LF does not Granger Cause HC	24	4.54204	0.0244
HC does not Granger Cause LF		4.43200	0.0263
TFP does not Granger Cause HC	24	2.16196	0.1426
HC does not Granger Cause TFP		5.15746	0.0162
TFP does not Granger Cause LF	24	20.9228	2.E-05
LF does not Granger Cause TFP		5.47702	0.0132

APPENDIX D

ARDL Cointegrating And Long Run Form
Original dep. variable: GDP
Selected Model: ARDL(1, 1, 1, 1, 0)
Date: 09/25/22 Time: 20:40
Sample: 1994 2019
Included observations: 25

Cointegrating Form				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(TR)	0.098340	0.071520	1.375002	0.1881
D(HC)	0.020408	0.280826	0.072672	0.9430

D(LF)	2.583986	2.698604	0.957527	0.3525
TFP	0.052111	0.017555	2.968533	0.0091
CointEq(-1)	-0.467104	0.157628	-2.963331	0.0092

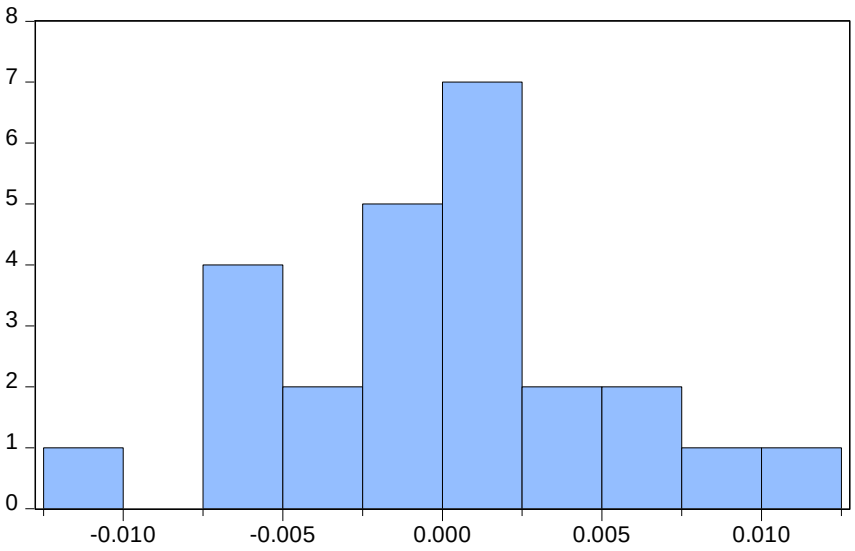
Cointeq = GDP - (0.4597*TR + 0.0142*HC + 3.0197*LF + 0.4877*TFP -1.9606)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TR	0.459676	0.054949	8.365460	0.0000
HC	0.014244	0.113175	0.125859	0.9014
LF	3.019682	0.790662	3.819180	0.0015
TFP	0.487682	0.065898	7.400577	0.0000
C	-1.960587	1.023821	-1.914970	0.0735

APPENDIX E

RESIDUAL DIAGNOSTIC



Series: Residuals
Sample 1995 2019
Observations 25

Mean	-2.04e-15
Median	0.001120
Maximum	0.010771
Minimum	-0.010718
Std. Dev.	0.005168
Skewness	0.090578
Kurtosis	2.720298
Jarque-Bera	0.115678
Probability	0.943802

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	2.504645	Prob. F(2,14)	0.1175
Obs*R-squared	6.587949	Prob. Chi-Square(2)	0.0371

Test Equation:
Dependent Variable: RESID
Method: ARDL
Date: 09/25/22 Time: 21:38
Sample: 1995 2019
Included observations: 25
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP(-1)	-0.021766	0.193947	-0.112224	0.9122
TR	0.027705	0.063848	0.433929	0.6710
TR(-1)	-0.028686	0.107167	-0.267672	0.7929
HC	0.066284	0.321417	0.206223	0.8396
HC(-1)	-0.044738	0.352573	-0.126890	0.9008
LF	-0.055448	4.759409	-0.011650	0.9909
LF(-1)	0.078811	4.016039	0.019624	0.9846
TFP	0.024892	0.113580	0.219161	0.8297
C	0.021139	0.934999	0.022608	0.9823
RESID(-1)	-0.607391	0.291175	-2.085999	0.0558
RESID(-2)	-0.111212	0.284803	-0.390486	0.7021

R-squared	0.263518	Mean dependent var	-2.04E-15
Adjusted R-squared	-0.262541	S.D. dependent var	0.005168
S.E. of regression	0.005807	Akaike info criterion	-7.159328
Sum squared resid	0.000472	Schwarz criterion	-6.623022
Log likelihood	100.4916	Hannan-Quinn criter.	-7.010579
F-statistic	0.500929	Durbin-Watson stat	2.120258
Prob(F-statistic)	0.862499		

HETEROSCEDASTICITY TESTS

Heteroskedasticity Test: Harvey

F-statistic	2.347653	Prob. F(8,16)	0.0696
Obs*R-squared	13.49954	Prob. Chi-Square(8)	0.0958
Scaled explained SS	5.728724	Prob. Chi-Square(8)	0.6776

Test Equation:
Dependent Variable: LRESID2
Method: Least Squares
Date: 09/25/22 Time: 21:45
Sample: 1995 2019
Included observations: 25

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-582.6335	196.1116	-2.970929	0.0090
GDP(-1)	-58.70879	40.21961	-1.459705	0.1637
TR	-15.55290	13.23356	-1.175262	0.2571
TR(-1)	36.81655	22.22938	1.656211	0.1172
HC	146.7921	67.61267	2.171074	0.0453
HC(-1)	-198.1207	74.08822	-2.674119	0.0166
LF	2582.633	999.5974	2.583673	0.0200
LF(-1)	-2040.951	842.2928	-2.423090	0.0276
TFP	8.418381	23.38635	0.359970	0.7236

R-squared	0.539982	Mean dependent var	-11.48222
Adjusted R-squared	0.309973	S.D. dependent var	1.476960
S.E. of regression	1.226879	Akaike info criterion	3.520538
Sum squared resid	24.08373	Schwarz criterion	3.959333
Log likelihood	-35.00672	Hannan-Quinn criter.	3.642241
F-statistic	2.347653	Durbin-Watson stat	2.842109
Prob(F-statistic)	0.069608		