Testing Gender and Race Non-linear Unemployment Invariance Hypothesis in South Africa: Evidence from Threshold Regression

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Abstract

This study employed South African data from 2008Q1 to 2021Q1 and a combination of OLS, FMOLS and threshold regression to test the validity of the existence or absence of a nonlinear Unemployment Invariance Hypothesis across race and gender, with the goal of determining whether the relationship between the unemployment rate and labour force participation rate is dependent on the unemployment regimes. The threshold regression results revealed that the relationship between unemployment and labour force participation varies by regimes. In other words, the impact of unemployment on labour force participation varies by gender and race and depends on the state of unemployment. In most cases, the discouraged worker hypothesis dominates, particularly at high unemployment rates (beyond predicted thresholds). This indicates that the relationship between the labour force participation rate and unemployment across different categories is dependent on the characteristics of the South African labour market, which is marked by structural and cyclical unemployment with structural inequities across races, sectors and groups. As a result, a persistently high unemployment rate in the South African labour market may lead to lower labour force participation, exacerbating the existing unemployment problem and eventually leading to permanent unemployment. Given our findings, the South African government should pursue substantial labour reforms that include educating and retraining existing unemployed workers, as well as creating an enabling environment conducive to job creation.

Keywords: Unemployment Invariance Hypothesis; Discouraged Worker Effect Hypothesis; Business Cycle; Threshold Regression

JEL Classification Codes: E24, J64, C24

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1. Introduction

South Africa is the third largest economy in Africa after Nigeria and Egypt which occupy the first and the second position respectively. In specific terms, the value of the GDP of South Africa in 2021 stood at $329.53 billion while the values of the GDP of Nigeria and Egypt stood at $514.05 billion and $392.28 billion respectively in the same year.[1] Despite this, two of these countries, Nigeria and South Africa in particular, are characterised by a high rate of unemployment. In fact, in the continent of Africa, South Africa has the highest rate of unemployment compared to Nigeria and Egypt. In the third quarter of 2021, the unemployment rate in South Africa stood at 34.9% whereas the unemployment rate in Egypt stood at 7.44% in the third quarter of the same year.[2] Nigeria's unemployment rate as of the fourth quarter of 2020 stood at 33.3%.[3]

The problematic unemployment in South Africa is gender, age, race, education, rural-urban and regional sensitivity. For instance, the third quarter report of the labour force survey of 2021 reveals that unemployment is higher among females than males, youth than adults (working age), blacks than whites, uneducated than educated, and rural people than urban people. This persistent rise in unemployment in South Africa is both a historical and recent occurrence phenomenon. Historically, some authors attributed the persistent rise in unemployment, especially among black people, to the policies of segregation instituted under the apartheid regime, particularly as related to the education and labour market policies (Raifu, 2017; Kwenda, Benhura and Mudiriza, 2020; Raifu, et al, 2024). The post-apartheid rise in unemployment has also been attributed to a mismatch between the skills required by the employers and skills possessed by unemployed persons, an increased rate of labour participation, especially by unskilled women, a defective labour market system, employment of more capital than labour, shrinkage of some sectors of the economy, increasing activities of labour market union and lots more (Arora and Ricci, 2005; Banerjee, et al., 2008; Leibbrandt, et al., 2010; Raifu and Afolabi, 2023; Raifu and Aminu, 2022; 2023; Raifu and Oshota, 2023).

This relationship between the unemployment rate and labour force participation rate has been empirically investigated under the three distinctive hypotheses. The first one is the discouraged worker effect hypothesis (hereafter DWEH) which states that the labour force participation rate depends on the condition or the state of the economy, especially the unemployment condition. The DWEH usually occurs during the period of the economic crisis when people are looking for jobs and are unable to find jobs which in turn lead to discouragement to further search for jobs (Emerson, 2011). The second one is the added worker effect hypothesis (hereafter AWEH) which occurs when unemployment that hits the household forces the member of that family to seek placement in the labour market (Österholm, 2010). Whether or not these first two hypotheses would hold depends on the outcome of the test of the third hypothesis known as the Unemployment Invariance Hypothesis-UIH (Gumata and Ndou, 2017). The UIH states that the labour force participation rate and unemployment rate are independent of each other. Put differently, it suggests that the unemployment rate does not depend on the labour force, capital stock and the level of production in the economy (Emerson, 2011). Thus, a policy to change the labour force, capital stock and productivity in order to influence the unemployment situation would not have any effect in the long run. To test the veracity of this hypothesis, researchers have employed different cointegration techniques to verify the relationship

[1]https://www.statista.com/statistics/1120999/gdp-of-african-countries-by-country/

[2] https://www.egypttoday.com/Article/3/109990/Egypt-s-unemployment-rate-hits-7-5-in-Q3-of

[3]https://www.proshareng.com/news/Nigeria%20Economy/Nigeria-s-Unemployment-Rate-Increases-to-33.3Percent-in-Q4-2020-from-27.1Percent-in-Q2-2020---NBS/56302

between the unemployment rate and unemployment rate which cuts across an individual country or panel of countries studies (Karanassou and Snower, 2004; Österholm, 2010, Emerson, 2011; Kakinaka and Miyamoto, 2012; Liu, 2014; Nguyen Van, 2016; Otoiu and Titan, 2016; Tansel, Ozdemir and Aksoy, 2016; Arisoy, 2018; Tansel and Ozdemir, 2018; Altuzarra, GálvezGálvez and González Flores, 2019; Nemore, Caferra and Morone, 2021; Congregado, et al., 2021; Raifu and Adeboje, 2022; Cheratian, Goltabar and Calá, 2022). Most of the enumerated studies used linear cointegration techniques, either time series cointegration techniques or panel cointegration techniques.

Recent studies, however, show that such an approach could lead to a spurious conclusion about the validity of UIH. Hence, these recent studies have proposed the use of a nonlinear approach to modelling the relationship between the unemployment rate and labour force participation rate for the following reasons. Congregado et al. (2021) argued that the relationship between the unemployment rate and labour force participation rate might have been subjected to structural break over time which may affect the long-run relationship between the two variables. Besides, Congregado, et al, (2014) submitted that the nonlinear relationship between the unemployment rate and labour force participation rate can be attributed to different relative sizes of the discouraged and added-worker effect for higher and lower levels of unemployment for different genders. In fact, Neftci (1984) had previously submitted that most macroeconomic data are time series and as such, they are not symmetric over the business cycle. Hence, modelling the relationship between or among those macroeconomic variables employing a linear estimation technique may not yield a plausible outcome or result.

As a result of the above, some studies have examined the nonlinear relationship between the unemployment rate and labour force participation rate (O'Brien, 2011 for Australia; Congregado, et al, 2014 for Spain; Lukianenko and Oliskevych, 2017 for Ukraine; Altuzarra, et al, 2019 for Spain Congregado, et al., 2020 for Eastern European countries Congredago, et al, 2021 for Poland). All the studies listed above were conducted in European countries where there has been a persistent rise in the unemployment rate since the Global Financial Crisis of 2007-2009. In order to fill the gap for developing countries, this study uses the data on the unemployment rate and labour force participation rate of South Africa to investigate the validity of UIH. Our estimation strategy is the threshold regression developed by Hansen (2002) which enables us to ascertain whether the relationship between the unemployment rate and labour force participation rate depends on the regimes of high and low unemployment situations or rather on the business cycle (Congregado, et al. 2020).

We first conduct a cointegration test using bounds testing approach to cointegration proposed by Pesaran et al. (2001). The essence is to examine whether there is a long-run relationship between the labour force participation rate and the unemployment rate. Second, we employ the Robust Ordinary Least Squares (OLS) and Fully Modified Ordinary Least Squares (FMOLS) to ascertain the linear response of the labour force participation rate to the unemployment rate. The analysis is done across total labour force participation and unemployment rate as well as gender labour force participation rate and unemployment rate. We consider the gender issue because it has been argued that women respond to unemployment conditions or situations more than men. In fact, two possibilities can occur. First, women may decide not to seek employment due to a prolonged fruitless search for jobs, that is, women can easily be discouraged from participating in the labour market (Hence the Discouraged Worker Effect). Second, women may also be forced to enter into the labour market when their husbands cannot secure employment or jobs on time - added worker effect (Cheratian, Goltabar and Calá, 2022). Furthermore, we extend our analysis of testing the validity of UIH across different races in

South Africa. It is well known that the labour force participation rate and unemployment rate differ across different races in the country. According to available data, White South Africans participate more in the labour force than the rest of the races. Similarly, they have a relatively low unemployment rate compared with the rest of the race. Thus, understanding the relationship between labour force participation and unemployment rate across different races could serve as input to the formation and implementation of the labour and macroeconomic policies designed to address skyrocketing unemployment plaguing the economy of South Africa.

The rest of the study is structured as follows. Section 2 reviews the existing studies. The methodology and data source are presented in section 3. Section 4 presents the empirical findings while section 5 concludes with policy implications.

2.0. Literature Review

2.1. Theoretical Literature Review

Since the seminal work of Layard and Nickell (1986) and the subsequent theory developed by Layard, Nickell and Jackman (1991), there has been much discussion in the economic literature on the relationship between the equilibrium rate of unemployment and other macroeconomic variables, especially the labour force participation rate. On the one hand, the unemployment invariance hypothesis (UIH) presupposes that the unemployment rate means reverting and is not affected by changes in the economy, and this view has been supported by many economic theorists. Some, however, argue that the aggregate unemployment rate has some association with the labour force participation rate and other economic factors. This relationship between the unemployment rate and the labour participation rate has led to the development of the added-worker effect hypothesis (AWEH) and the discouraged-worker effect hypothesis (DWEH).

Layard, Nickell and Jackman (1991) modelled the non-accelerating inflation rate of unemployment (NAIRU) as exogenous and not influenced by labour force participation, capital accumulation and technical progress. This conclusion that unemployment is invariant to economic realities is arrived at by assuming perfect substitution between labour and capital such that the investment in additional capital that should have reduced unemployment is offset by wage increases. Similarly, increases in labour supply cause the wage-setting curve to adjust, leaving the unemployment rate constant (Karanassou and Snower, 2004). Hence, the UIH is often generalised to refer to a situation where there is no long-run relationship between unemployment and labour force participation rate (Arisoy, 2018; Tansel, Ozdemir and Aksoy, 2016).

Citing empirical evidence of unemployment hysteresis in Europe in the 1970s, Rowthorn (1999) argued against the unemployment invariance hypothesis. Rowthorn extended the model in Layard, Nickell and Jackman (1991) by assuming less than unity elasticity so that the changes in wages do not completely offset the employment effects of capital accumulation, labour force participation and total factor productivity. A long-run relationship, therefore, implies that the unemployment rate is not invariant to changes in the economy. Several scholars have also questioned the UIH, espousing the association between unemployment and labour force participation through the added-worker effect hypothesis (AWEH) and the discouraged-worker effect hypothesis (DWEH).

The AWEH suggests a positive relationship between the unemployment rate and the labour participation rate, and this added-worker effect is especially seen in a family setting. Due to

the earning losses as a result of the unemployment of a member, other members who were previously outside the labour force could increase their labour supply to offset the expected loss in income (Bredtmann, Otten and Rulff, 2017; Lee and Parasnis, 2014). On the other hand, high unemployment could lead to lower labour force participation through the discouraged worker effect. The DWEH predicts a negative relationship between the unemployment rate and the labour force participation rate. With a high unemployment rate and protracted periods of being unemployed, individuals could be discouraged from seeking jobs and voluntarily withdraw from the labour force since they do not get job offers and the probability of getting a job remains reduced (Clark and Summers, 1979; Gumata, 2017; Tansel and Ozdemir, 2018).

2.2. Empirical Literature Review

The dynamics of the unemployment rate and labour force participation rate have also received much attention in the economic literature. Empirical studies have tested the validity of the unemployment invariance hypothesis across countries and demography. While some studies have validated it, some studies have refuted it, and others have found mixed cases of both the presence and absence of long-run relationships. In Turkey, for instance, Arisoy (2018) and Tansel, Ozdemir and Aksoy (2016) supported the UIH since no evidence of a long-run relationship between unemployment and labour force participation was found. Rejecting the UIH, Gumata (2017) found discouraged-worker effects to be prevalent in South Africa. Other studies supporting the DWEH include Österholm (2010) in Poland, Palamuleni (2017) in the US, Yildirim (2024) in Belgium, Raifu and Adeboje (2022) in Africa and Paternesi Meloni (2024) in OECD countries. This suggests that increasing unemployment would drive down the rate of labour force participation. On mixed evidence, Altuzarra, Gálvez and Flores (2018) found the UIH to hold for Spain's aggregate labour force and male labour force while the discouraged-worker effect is observed for the female working population. Similarly, Kakinaka and Miyamoto (2011) viewed the UIH as binding among female workers in Japan while the added-worker effect is found to exist among young males and the discourage-worker effect among older males. Also, Yilanci and Ozgur (2024) find the existence of the discouraged-worker effect for males and the added-worker effect for females in South Korea.

Furthermore, these studies have adopted several methodologies and econometric approaches to arrive at the different justifications for the UIH, DWEH and AWEH. Although a significant proportion of the literature has examined the relationship between both variables without using approaches that explicitly account for nonlinearity, other studies have attempted to validate which of the hypotheses holds in the presence of non-linearities and asymmetries. The aforementioned studies fall into the former category, using models such as the vector error correction model (Altuzarra et al, 2018), the dynamic ordinary least squares model and the pooled ordinary least squares model (Raifu and Adeboje, 2022), and the autoregressive distributed lag model (Arisoy, 2018). In the case of South Africa, Gumata (2017) specified a vector autoregressive (VAR) model similar to Kakinka and Miyamoto (2012) and Österholm (2010).

Nonlinear econometric techniques have been adopted because the unemployment rate and the labour force participation rate often behave nonlinearly depending on whether the economy is in a boom or recession (Lee, 2010). As a result, several studies have modelled the concerned variables as smooth autoregressive transition (STAR) processes since STAR models help in capturing the smooth transitions that the variables undergo – relating to the business cycle. Cengiz and Sahin (2014) adopted a STAR model for labour force participation rates in Turkey, and they provide evidence for the DWEH during recessions and the AWEH during booms. Their disaggregated analysis across genders also reveals that female workers have sharper

transitions with a higher smoothness parameter. The asymmetric threshold-disturbance autoregressive model and threshold-disturbance moving average model have also been popularly used in testing for nonlinearity in unemployment and labour force participation. Upon finding evidence of asymmetries in the Ukrainian labour market, for instance, Lukianenko and Oliskevych (2017) specified a nonlinear logistic smooth transition autoregressive model (LSTAR) which shows the dominance of the added-worker effect during economic crises. In Latin America, Maridueña-Larrea and Martín-Román (2023) discovered that whether UIH, DWEH or AWEH would be established depends on the state of the economy. For instance, in times of recession, it is found that Ecuador and Mexico exhibit a countercyclical rate for female labour force participation, affirming the added labour effect dynamically. However, during expansion, a procyclical behaviour is detected for the female labour force participation in Uruguay and Chile confirming the added worker hypothesis. Also modelling the labour force participation rate as nonlinear, Congregado et al (2020) employed both the threshold regression and the smooth transition regression analyses, from which they obtain results that are consistent with discouraged-worker effects in Poland when the unemployment rate is above 13%. In line with Hansen (2000), the threshold estimation shows the prevalence of the added-worker effect up to a certain point, and they verified the smoothness of the switching across the threshold using a STAR model. Extending their empirical research on Poland, Congregado et al (2021) tested for a long-run relationship in the presence of structural breaks and across gender, and they find mixed evidence of added-worker and discouraged-worker effects across age and gender groups.

Supporting the nonlinear unemployment invariance hypothesis for 29 Organisation for Economic Co-operation and Development (OECD) countries, Lee (2010) models unemployment following the panel exponential smooth transition (PESTAR) process and a bootstrap procedure in the panel unit root testing. A sequential panel selection method (SPSM) is then adopted to classify the understudied countries into stationary and non-stationary countries, and through this categorisation, the study reports evidence of nonlinear stationarity, implying invariance and support for the natural rate of unemployment hypothesis.

In the light of possible asymmetries in the South African labour market, this study extends the research by Gumata (2017) by investigating the unemployment invariance hypothesis for the South African economy, accounting for the potential nonlinearity and cyclicality in the labour participation rate and unemployment rate.

3.0. Methodology and Data Sources

3.1. Methodology

This study aims to test the nonlinear unemployment invariance hypothesis in South Africa. To test the nonlinear UIH, we employ a threshold regression developed by Hansen (2000). However, we conducted some preliminary tests to ascertain the properties of the variables (unemployment and labour force participation) utilised. We also tested for the existence of cointegration between unemployment and labour force participation across gender and race. For the unit root test, the famous Augmented Dickey-Fuller unit root test (Dickey and Fuller, 1981) and Phillips-Perron unit root test (Phillips and Perron, 1988) are employed. Both methods, though slightly different, assume that the series contains a unit root. This null hypothesis is often tested against the alternative hypothesis which states that the series is stationary at level. In practice, the null hypothesis is rejected when the probability value of the test statistics is less than or equal to 5%, suggesting that the variables are stationary at level. In other words, the variables are I(0) series. However, if the probability value is greater than 5%, this means that the variables indeed contain a unit root, that is, not stationary and such variables

can only become stationary after the first difference (Raifu and Abodunde, 2021). After the unit root test, we conduct a cointegration test using the ARDL bounds testing approach to cointegration (Pesaran, et al., 2001). Pesaranet al's approach to cointegration is applicable irrespective of the order of integration of the variable, either integration of order 0 and 1 except for integration of order 2 (Raifu, Obijole and Nnadozie, 2022). The purpose of conducting a cointegration test is to determine whether there exists a long-run relationship between unemployment and labour force participation. When the cointegration between the two series is established, it means that the hypothesis of the Discouraged Worker Effect holds.

Having determined or ascertained the presence of cointegration between unemployment and labour force participation, we first used two linear estimation techniques (OLS and FMOLS) to examine the influence of the labour force on unemployment in South Africa taking into consideration the issue of gender and racial unemployment and labour force participation. However, we do not provide the econometric frameworks for OLS and FMOLS because they are just used to confirm the effect of unemployment on labour force participation. Put differently, the two methods are just used for preliminary analysis. The main goal of this study is to examine or test the validity of the nonlinear unemployment invariance hypothesis using Hansen's spline and threshold regression. Hence, only the threshold framework is presented in this study. Following the original work of Hansen (2000) and as specified by Chen and Lee (2005), the threshold regression is specified as follows:

$$y_t = \alpha_1^{'} x + \varepsilon_{1t} \quad \text{if } q_t \le \gamma \tag{1}$$

$$y_t = \alpha_2^{'} x + \varepsilon_{2t} \quad \text{if } q_t \succ \gamma \tag{2}$$

From equations 1 and 2, q_t is referred to as the threshold variable used to divide the sample into two groups which may be called classes or regimes. y_t is referred to as the dependent variable. The dependent variable in this study is labour force participation rates for different gender groups (total, male and female) and races (Black, White, Indian/Asian and Coloured). x_t is an independent variable which in this study is the unemployment rates for different gender groups (total, male and female) and race (Black, White, Asian/India and Coloured). ε_{it} is the error term assumed to be independently and identically distributed with zero mean and constant variance and γ is a threshold value. The interpretation of equations 1 and 2 goes thus. When the threshold variable is smaller compared with the threshold value, then we have equation 1. However, when the threshold variable is greater than the threshold value, we have equation 2. If it is assumed that the dummy variable $I_I(\gamma) = \{q_t \le \gamma\}$ and $\{\bullet\}$ is referred to as an indicator function, the if $q_t < \gamma$ we have $I = 1$, otherwise $I = 0$. If $x_t(\gamma)$ and $x_t I_I(\gamma)$, then equations 1 and 2 can be rewritten as follows:

$$y_t = \alpha^{'} x_t + \beta^{'} x_t(\gamma) + \varepsilon_t \qquad \varepsilon_t \sim iid(0, \delta^2) \tag{3}$$

Where $\alpha = \alpha_2$, $\beta = \alpha_1 - \alpha_2$ and $\varepsilon = [\varepsilon_{it} \varepsilon_{2t}]^{'}$. Through equation 3, the regression parameters can be made to switch between regimes α, β and γ are the parameters required to be estimated. The parameters can be estimated using the least squares with the sum of squares errors function given as:

$$S_n(\alpha,\beta,\gamma) = (Y - X\alpha - X_\gamma\beta)'(Y - X\alpha - X_\gamma\beta) \quad (4)$$

In equation 4, the least squares estimators minimise the sum of the square errors. The sum of squares errors can be written in a concentrated manner as follows

$$S_1(\gamma) = \hat{\varepsilon}_t(\gamma)' \hat{\varepsilon}_t(\gamma) \quad (5)$$

The optimal threshold value can be expressed as follows:

$$\hat{\gamma} = \arg\min S_1(\gamma) \quad (6)$$

The variance of the error term is specified as follows

$$\hat{\sigma}^2 = \frac{1}{T}\hat{\varepsilon}_t' \hat{\varepsilon} = \frac{1}{T} S_1(\hat{\gamma}) \quad (7)$$

Generally, the models that would be estimated in this study are given as follows

$$LFP_t = \alpha_{10} + \alpha_{11} UNPL_t + \varepsilon_t \text{ if } UNPL_t \leq \gamma \quad (8)$$

$$LFP_t = \alpha_{20} + \alpha_{21} UNPL_t + \varepsilon_t \text{ if } UNPL_t \succ \gamma \quad (9)$$

Where LFP represents the labour force participation rate across gender and race and UNPL is the unemployment rate across gender and race.

3.2. Data Sources and Descriptive Statistics

This study employed quarterly data ranging from 2008Q1 to 2021Q1. The data include the total labour participation rate for gender (male vis-à-vis female) and race (Black, White, Indian/Asian and Coloured) and unemployment rate (male vis-à-vis female) and race (Black, White, Indian/Asian and Coloured). Both variables (labour force participation rate and unemployment rate) are sought from STATS SA (Department: Statistics South Africa).[4] The variables are measured in percentage.

The descriptive statistics of the variables employed in this study are presented in Table 1. The average total unemployment rate during the period under review is 25.9% with the rates ranging from 21.9% to 32.6%. The median value is 25.3%, which is quite lower than the average value for the group, indicating a rightly-skewed distribution and suggesting that the mean is only being influenced by few higher unemployment rates. However, the average total labour force participation rate for the economy is 57.1%, which is slightly lower than the median of 57.3%, indicating a near symmetry or a left-skewed distribution. Furthermore, the average total women's unemployment rate is higher than the men's unemployment rate with the former being 28.3% while the latter is 24.0% while the two categories exhibited rightly-skewed distribution as their respective average values are greater than the corresponding median rates. This is further corroborated by the labour force participation rate as that of men (63.7%) is higher than that of women (50.5%), suggesting that men are more active in the labour market than women. Out of the races analysed, blacks have the highest unemployment rate of 29.6% and the lowest average labour force participation rate of 55.0%. However, whites have the lowest average

[4]https://www.statssa.gov.za/

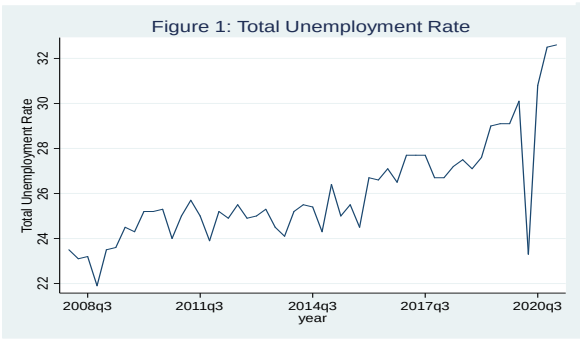
unemployment rate of 6.4% and the highest average labour force participation rate of 68.0%. This suggests an inverse relationship between the unemployment rate and labour force participation rate among blacks and whites. However, the coloured has a higher average unemployment rate and labour force participation rate than the Indian-Asian. While the coloured has an unemployment rate of 22.6%, the Indian Asian has an average unemployment rate of 11.8%. Similarly, the labour force participation rate of the coloured is 63.3% on average, while that of the Indian-Asians is 59.4%.

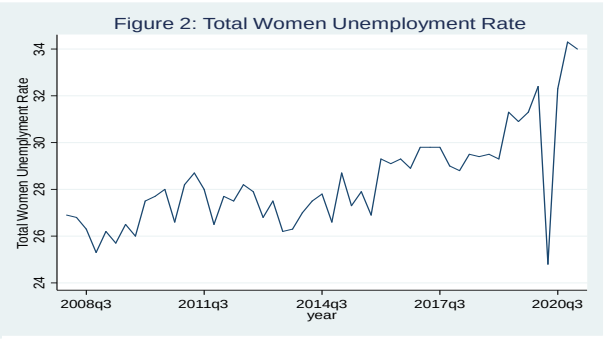
Table 1: Descriptive Statistics

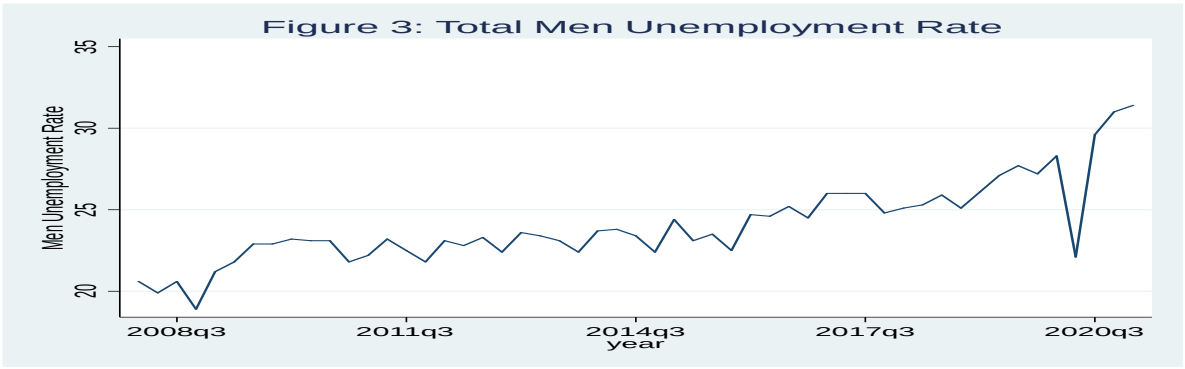
Variables	Obs	Mean	Median	Std.Dev.	Min	Max	p1	p99	Skew.	Kurt.
TUNEMP	53	25.989	25.300	2.269	21.900	32.600	21.900	32.600	1.049	4.067
TLFPR	53	57.108	57.300	2.425	47.300	60.500	47.300	60.500	-1.278	6.068
TWUNEMP	53	28.330	27.900	2.054	24.800	34.300	24.800	34.300	0.966	3.859
TWLFPR	53	50.589	50.800	2.545	41.700	54.600	41.700	54.600	-0.741	3.965
TMUNEMP	53	24.043	23.400	2.53	18.900	31.400	18.900	31.400	0.894	4.061
TMLFPR	53	63.740	63.900	2.358	53.000	66.600	53.000	66.600	-1.811	9.024
BTUNEMP	53	29.634	29.100	2.293	25.600	36.700	25.600	36.700	1.203	4.643
BTLFPR	53	55.026	55.200	2.961	45.400	59.200	45.400	59.200	-0.647	3.261
CTUNEMP	53	22.675	23.000	1.787	17.900	25.700	17.900	25.700	-0.793	3.154
CTLFPR	53	63.313	63.900	2.843	49.700	66.500	49.700	66.500	-3.070	13.468
IATUNEMP	53	11.851	11.800	1.817	7.900	18.400	7.900	18.400	0.637	5.208
IATLFPR	53	59.445	59.400	1.689	55.900	62.900	55.900	62.900	-0.173	2.453
WTUNEMP	53	6.419	6.600	1.197	3.000	8.800	3. 000	8.800	-0.406	3.006
WTLFPR	53	68.013	68.000	1.319	61.800	71.100	61.800	71.100	-1.596	10.989

Note: TUNEMP, TLFPR, TWUNEMP, TWLFPR, TMUNEMP, TMLFPR, BTUNEMP, BTLFPR, CTUNEMP, CTLFPR, IATUNEMP, IATLFPR, WTUNEMP and WTLFPR are total unemployment rate, total labour force participation rate, women unemployment rate, women labour force participation rate, men unemployment rate, men labour force participation rate, black unemployment rate, Black labour force participation rate, black unemployment rate, Coloured labour force participation rate, Indian/Asian unemployment rate, Indian/Asian labour force participation rate, white unemployment rate and white labour force participation rate respectively.

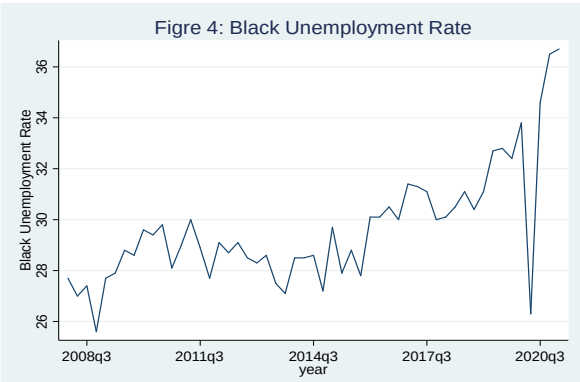
Total and Gender Unemployment Rate (15-64 years)

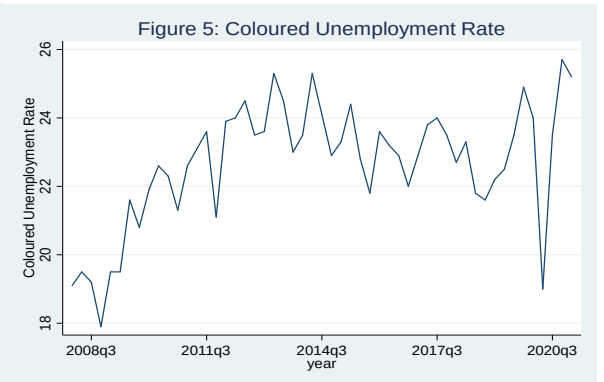


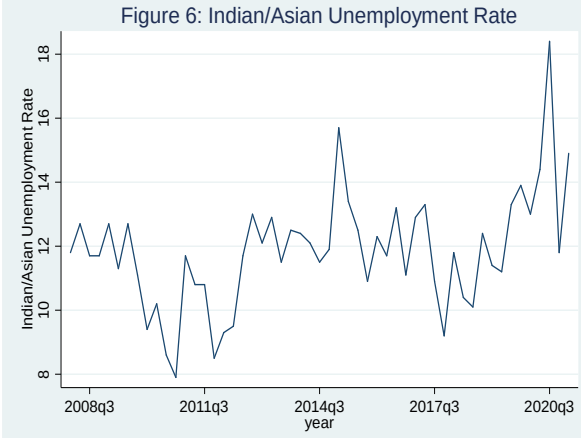


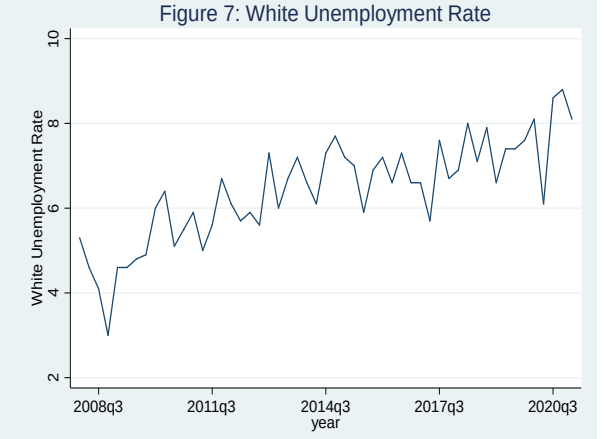


Racial Unemployment Rate (15-64 years)

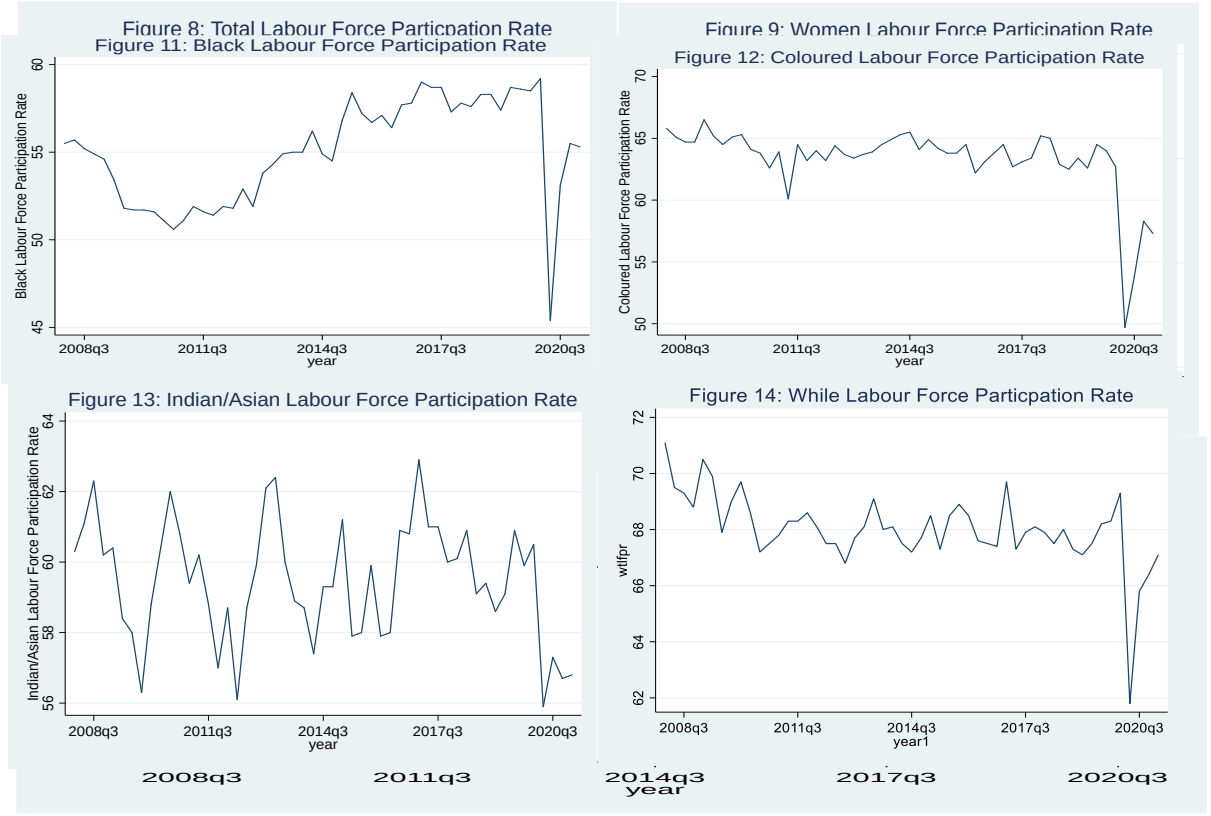








Total and Gender Labour Force Participation (15-64 years)



Racial Labour Force Participation Rate (15-65 years)

4.0 Empirical Findings

4.1 Unit Root Test Results

In this study, the unit root test was used to identify the order of integration of the variables. The Augmented Dickey-Fuller (ADF) (Dickey and Fuller, 1981) and the Philips-Perron (PP) (Phillips and Perron, 1988) unit root tests were both used to determine the stationary properties of the data series used in this study. The ADF and PP both tested the null hypothesis that a series has a unit root or is non-stationary against the alternative hypothesis that the series has no unit root. Table 2 provides a summary of the unit root tests' results at both levels and the first difference. The ADF and PP tests both accepted the null hypothesis of a unit root in the data series at levels, showing that all the variables are non-stationary at levels. However, the null hypothesis of unit root is rejected by the two tests after first differencing the variables, thus they are stationary at the first difference, suggesting that they are all integrated of order 1.

Table 2: Unit Root Test

	Level			First Difference			Decision
	WC	WC&T	WDC&T	WC	WC&T	WDC&T	
Augmented Dickey-Fuller Unit Root Test							
TUNEMP	-0.026	-5.280	2.363	-6.688***	-6.632***	-6.012***	I(1)
TLFPR	-3.829***	-4.126	-0.243	-10.494***	-5.424***	-10.598***	I(1)
TWUNEMP	0.164	-5.670***	1.646	-6.171***	-5.601***	-5.887***	I(1)
TWLFPR	-3.258**	-3.782**	-0.185	-9.718***	-5.466***	-9.816***	I(1)
TMUNEMP	-0.325	-4.893***	2.552	-6.542***	-6.459***	-5.709***	I(1)
TMLFPR	-3.980***	-4.074**	-0.364	-10.397***	-5.324***	-10.490***	I(1)
BTUNEMP	-0.046	-4.604***	1.881	-6.048***	-6.035***	-5.646***	I(1)
BTLFPR	-3.081**	-3.776**	-0.130	-10.036***	-5.228***	-10.138***	I(1)
CTUNEMP	-3.193**	-2.565	1.366	-7.701***	-8.074***	-7.453***	I(1)
CTLFPR	-2.953**	-3.680**	-0.616	-6.439***	-6.734***	-8.825***	I(1)
IATUNEMP	-4.145***	-4.794***	0.226	-7.732***	-7.755***	-7.788***	I(1)
IATLFPR	-3.847***	-3.888**	-0.515	-9.076***	-8.989***	-9.139***	I(1)
WTUNEMP	-1.291	-6.277***	1.188	-8.656***	-8.545***	-8.452***	I(1)
WTLFPR	-5.346***	-6.443***	-1.189	-5.035***	-4.972***	-7.376***	I(1)
Phillips-Perron Unit Root Test							
TUNEMP	-1.529	-5.234***	2.618	-15.938***	-20.073***	-12.544***	I(1)
TLFPR	-3.803***	-4.120**	-0.309	-14.260***	-13.970***	-14.123***	I(1)
TWUNEMP	-2.529	-5.650***	1.795	-17.130***	-23.609***	-14.123***	I(1)
TWLFPR	-3.098**	-3.684**	-0.195	-12.600***	-12.406***	-12.836***	I(1)
TMUNEMP	-1.238	-4.884***	2.791	-15.112***	-16.594***	-12.158***	I(1)
TMLFPR	-3.958***	-4.042**	-0.515	-13.618***	-13.385***	-13.533***	I(1)
BTUNEMP	-2.118	-4.604***	-2.074	-14.906***	-17.897***	-12.916***	I(1)
BTLFPR	-2.874*	-3.714**	-0.096	-12.286***	-12.083***	-12.451***	I(1)
CTUNEMP	-3.311**	-3.775**	1.162	-12.354***	-12.552***	-11.509***	I(1)
CTLFPR	-2.902*	-3.688**	-1.337	-17.187***	-21.028***	-11.928***	I(1)
IATUNEMP	-4.336***	-4.849***	0.200	-14.126***	-14.506***	-14.191***	I(1)
IATLFPR	-3.959***	-3.888**	-0.716	-11.677***	-11.590***	-11.599***	I(1)
WTUNEMP	-2.491	-6.336***	0.766	-24.900***	-24.496***	-16.331***	I(1)
WTLFPR	-5.346***	-6.424***	-1.301	-26.494***	-26.564***	-20.748***	I(1)

Note: TUNEMP, TLFPR, TWUNEMP, TWLFPR, TMUNEMP, TMLFPR, BTUNEMP, BTLFPR, CTUNEMP, CTLFPR, IATUNEMP, IATLFPR, WTUNEMP and WTLFPR are total unemployment rate, total labour force participation rate, women unemployment rate, women labour force participation rate, men unemployment rate, men labour force participation rate, black unemployment rate, Black labour force participation rate, black unemployment rate, Coloured labour force participation rate, Indian/Asian unemployment rate, Indian/Asian labour force participation rate, white unemployment rate and white labour force participation rate respectively.

4.2 Cointegration Tests

To determine if the variables exhibit a long-run relationship, cointegration tests were conducted using the ARDL bounds testing approach. The results, shown in Table 3, indicate that only the Indian-Asian and White race models exhibit cointegration at the 5% and 1% significance levels respectively, as their test statistics exceed the critical values. This suggests a long-run relationship between unemployment and labour force participation for these groups, whereas no cointegration is observed for the Black (African) and Coloured race models or in the total and gender-disaggregated data. The absence of cointegration among these groups implies that changes in one variable do not reliably predict changes in the other. This could stem from structural mismatches such as skill gaps or policy inefficiencies in the South African economy, where reducing unemployment does not necessarily increase labour market participation and vice versa (Burger & Von Fintel, 2009; Banerjee et al., 2008).

Table 3: ARDL Bounds Testing Approach to Cointegration

Test	F-statistic
LTUNEMP	1.96
LTWUNEMP	1.64
LTMUNEMP	2.41
LBTUNEMP	1.68
LCTUNEMP	1.34
LIATUNEMP	7.00**
LWTUNEMP	12.98***

Note:

(i) Critical Value: 1% (Lower bound: 7.56; Upper bound: 8.69)
(ii) Critical Value: 5% (Lower bound: 5.22; Upper bound: 6.07)
(iii) Critical Value: 10% (Lower bound: 5.16; Upper bound: 4.93)

4.3 Linear Regression

Following the establishment of the long-run relationship among the variables, this subsection discussed the regression analysis results obtained from the empirical model. Specifically, the baseline OLS regression method is employed first as presented in Table 4, after which the Fully Modified OLS is adopted (Table 5). The choice of the FMOLS is premised on the outcome of the unit root and cointegration tests earlier carried out, as all the variables are integrated of order 1, while they all have a long-run relationship among themselves.

According to Tables 4 and 5, there is a positive and significant relationship between the total unemployment rate and the total labour force participation rate. This suggests the existence of the Added Worker Effect Hypothesis (AWEH) in the aggregate linear model, which is supported by Osterholm (2010). This finding corroborates the findings of Raifu and Adeboje (2022) that there exists a positive linear relationship between labour force participation and unemployment rates in South Africa, thus signalling a robust labour market in the country. This is further supported by Musa, et al. (2014) who found a positive correlation and long-term relationship between unemployment rate and labour force participation rate in the Sub-Saharan Africa. This suggests an elastic labour supply in response to macroeconomic shocks occasioned by the unemployment rate, although the increased participation rate of the labour force may cause unemployment surge in the short run. Furthermore, the linear positive relationship between unemployment rate and labour force participation rate also exists for the respective models of men, women and black race. This is in line with the findings of Sabarwal, Sinha and Buvinic (2010) that women labour participation rates tend to increase during economic crises, especially in economies with limited welfare framework. According to Sabarwal et al (2010), labour force participation rates of women from low-income households increase during economic crises unlike those from rich households whose labour force participation rate declines in response to the crises. It is also evident, from Sarbarwal et al (2010) findings that one of the strategies of increasing labour force participation among women in low-income households is to defer their fertility in response to the economic crises.

However, there exists a negative and significant relationship between unemployment rate and labour force participation rate for white and coloured races, suggesting the presence of the Discouraged Worker Effect Hypothesis among white race and coloured race workers in South Africa as supported by Mkhize and Ndlangamandla (2022). It is noteworthy that the Indian-Asian race has a mixed signed insignificant coefficient in the two models of Tables 4, suggesting that their participation in the labour market is not significantly driven by labour force outcomes like unemployment. The results further imply that the decision to either leave

or enter the labour market by workers in South Africa is linearly dependent on race. The negative relationship between unemployment rate and labour force participation rate among the white and coloured races is supported by Bhorat, Ncube and Vencatachellum (2019) which hinted on how the rising rate of unemployment among skilled workers, especially the white population has made discouraged worker to cease their job search, thus leading to reduction in their participation in the labour force. Evidence from Carmichael and Louw (2020) also showed that higher unemployment rates in the times of economic restructuring in South Africa led to decline in white population participating in the labour force, as many of this population withdraw from the labour force due to the perception of dearth in job opportunities.

Table 4: OLS Robust Standard Results

DEPENDENT VARIABLE	LTLFPR	LTWLFPR	LTMLFPR	LBTLFPR	LCTLFPR	LIATLFPR	LWTLFPR
Total unemployment rate	0.190**						
	(0.089)						
women unemployment rate		0.349***					
		(0.127)					
men unemployment rate			0.079				
			(0.059)				
black unemployment rate				0.305***			
				(0.113)			
Coloured unemployment rate					-0.015		
					(0.138)		
Indian/Asian unemployment rate						-0.010	
						(0.030)	
white unemployment rate							-0.032***
							(0.010)
CONSTANT	3.426***	2.756***	3.903***	2.975***	4.195***	4.109***	4.278***
	(0.290)	(0.424)	(0.188)	(0.383)	(0.435)	(0.074)	(0.019)
OBSERVATIONS	53	53	53	53	53	53	53
R-SQUARED	0.133	0.229	0.044	0.171	0.001	0.003	0.107

Standard errors are in parenthesis; *** p<0.01, ** p<0.05, * p<0.1

Table 5: Fully Modified OLS Regression Results

DEPENDENT VARIABLE	Total LFPR	women LFPR	men LFPR	black LFPR	Coloured LFPR	Indian/Asian LFPR	white LFPR
Total unemployment rate	0.359***						
	(0.090)						
women unemployment rate		0.636***					
		(0.224)					
men unemployment rate			0.180***				
			(0.044)				
black unemployment rate				0.547*			
				(0.284)			
Coloured unemployment rate					-0.386***		
					(0.140)		
Indian/Asian unemployment rate						0.003	
						(0.004)	
white unemployment rate							-0.044***
							(0.010)
CONSTANT	2.882***	1.807**	3.588***	2.164**	5.361***	4.078***	4.301***
	(0.294)	(0.748)	(0.141)	(0.961)	(0.437)	(0.009)	(0.019)
OBSERVATIONS	52	52	52	52	52	52	52
R-SQUARED	0.244	0.243	0.141	0.218	-0.171	0.007	-0.117

Standard errors are in parenthesis; *** p<0.01, ** p<0.05, * p<0.1

Note: LFPR denotes Labour Force Participation Rate.

4.4 Threshold Regression

We have earlier discussed the linear relationship between unemployment and labour force participation rate. However, there may still exist a non-linear relationship which often arise due to the dynamic and neutralising effect of both Added Worker Effect and Discouraged Worker Effect at various stages of business cycle. During economic crises, household having economic losses from unemployment often prompt their secondary earners (women most especially) to participate in the labour market, thus leading to a short run increase in labour force participation relative to unemployment, a good macroeconomic instability indicator. However, as the secondary earners' capacity to enter labour market gets depleted, the labour force participation reduces and hence results in lower relationship between the two variables. This thus introduces the non-linear relationship between unemployment and labour force participation in the context of Added Worker Effect (AWE). For the Discouraged Workers Effect (DWE), as unemployment persists in the labour market, many people become discouraged in getting job, thus leading to the decline in their participation in the market. It is noteworthy that, at a time in the context of DWE, unemployment may exceed a particular threshold thus countering the initial effect of AWE. Therefore, depending on the macroeconomic context and socioeconomic structure, the aforementioned interactions can produce a non-linear relationship between unemployment and labour force participation rate.

It is on the above premise that we explored the use of threshold regression approach in this paper. As previously stated, we used Hansen's (1996, 2000) sample splitting threshold approach to study the threshold effect of unemployment on labour force participation rate. The Threshold regression results for the analysis are displayed in Table 6. The threshold regression allows for the unemployment rate in the respective models to be split into two regimes, that is, regimes of low and high unemployment rate. An unemployment rate is said to be low if it is equal or below the corresponding threshold level while an unemployment rate above the respective threshold level is said to be high.

The full sample of the entire model is presented in the second column of Table 6. There exists a negative but insignificant relationship between unemployment and labour force participation at an unemployment rate of 3.25% and below. The insignificant relationship may be premised on the regional and sectoral variations, as well as labour market segmentation in the South Africa labour market. A highly segmented South African labour market, with both highly skilled labour force in a formal market space and low skilled labour force who are informal-sector workers, would have heterogenous responses of labour force participation to unemployment, which may inform the insignificance nature of the relationship. These divergent views are further supported in findings from Ranchhod and Daniels (2021); Banerjee, et al. (2008), among others. However, the coefficient estimate is significantly negative when the unemployment rate is above the threshold of 3.25%. This could suggest that the higher the total unemployment rate above the threshold rate, the higher the possibility of the Discouraged Worker Effect Hypothesis (DWEH) in the South African labour market. That is, at a lower rate of unemployment, there could be the presence of DWEH but at an insignificant measure; however, as the rate of unemployment increases beyond the threshold of 3.25%, the presence of DWEH becomes stronger. Combining this finding with the linear model, we could suggest the existence of a positively significant relationship between the labour force participation rate and unemployment at the rate of 3.25% or below, that is, Added Worker Effect Hypothesis (AWEH) while the unemployment rate above the threshold unemployment rate would result into the Discouraged Worker Effect Hypothesis (DWEH). Having discussed the sample above, the segregated estimated models are discussed subsequently.

For the women (column 3), the unemployment rate and labour force participation rate exhibit a positive and insignificant relationship when the threshold of unemployment rate is 3.36%. This relationship could be termed Added Worker Effect Hypothesis (AWEH), but the insignificant could be premised on limited employment opportunities occasioned by the inability of the labour market to take in labour force new entrants, especially women. However, when unemployment is beyond the threshold of 3.36%, the Discouraged Worker Effect (DWE) outweighs the initial Added Worker Effect (AWE) which could be due to some structural constraints faced especially by women in South Africa, thus turning the relationship to being negative and significant. Banerjee, et al. (2021) noted the cyclical dominance of the AWE among the less privileged groups, especially women, during economic crisis in the short run, but also underscored the emergence of DWE in the prolonged economic crises. This is also applicable to the blacks in the region (as shown in column 5). Similarly, Posel and Casale (2020) emphasised how structural barriers and limited job opportunities fuelled the negative relationship between unemployment and female labour force participation, notwithstanding the higher rate of educational attainment among women. The non-linear effect in the South Africa labour market is further noted by Leibbrandt, et al. (2018) which affirmed the transitioning of unemployment from cyclical to structural, affirming that women are disadvantaged in the labour market due to their roles in the family as well as informal labour reliance.

The relationship between male unemployment rate and male labour force participation rate is negative in both short and long run, but significant and insignificant in the two periods, respectively. As a conventional primary earner in the household, men tend to be under social pressure to secure job as unemployment increases. As unemployment lingers with the threshold of 3.15%, they tend to be discouraged and reduce their participation in the labour market. Further elongation of unemployment beyond the threshold further reduces the relationship and renders it insignificant, as men would have withdrawn or left the labour market for other alternative income generating jobs that are not necessarily captured in the formal labour market due to fatigue and other pressures (Blundell, et al. (2018). Kingdon and Knight (2020) further corroborated that lingering unemployment in South Africa leads to withdrawal from the labour market in the short run, which could lead to structural unemployment as this persists. Similar to the relationship that exists among men, the Indian/Asian unemployment rate has a negative relationship with their labour force participation rate across the two regimes. However, the relationship is insignificant when the threshold unemployment is 3.40% but becomes significant as the unemployment rate persists beyond the threshold.

Finally, the relationship among the whites is negative and progressively significant across the two regimes, confirming the presence of Discouraged Worker Effects among them. The significant disparity across racial groups in South Africa could account for this. When the unemployment rate is moderately within the threshold of 1.80%, the negative relationship between unemployment and labor force participation reflects a more gradual discouraged worker effect. Workers facing difficulty in securing jobs may continue to search actively, resulting in higher labor force participation. However, as unemployment rates rise, confidence in job prospects diminishes for a growing subset of workers, gradually reducing participation. As the unemployment rate persists and rises beyond the threshold, the labour market signals become overwhelmingly negative, leading to a sharper increase in discouraged workers (Krueger, Cramer and Cho, 2014). These workers are likely to exit the labour force entirely, significantly lowering the participation rate. Additionally, limited social safety nets In South Africa may accelerate labour force withdrawal once unemployment persists beyond the threshold. It is noteworthy also that high unemployment increases search frictions, as fewer vacancies are available, leading to longer durations of unemployment, especially with South

Africa's labour market characterized by structural and cyclical unemployment (Banerjee, et al., 2008; Elsby, et al., 2015)

Summarily, the dependence of labour force participation rate on unemployment across the different categories of players in the South African labour market is hinged on the characteristic nature of the South Africa labour market characterised by structural and cyclical unemployment, with structural disparities across race, sectors and groups. It is noteworthy that different race responds differently to the relationship between unemployment and labour force participation due to economic segmentation, institutional factors like limited social safety nets and long-term mismatch between the skills of unemployed workers and available jobs.

Table 6: Threshold Regression Results

DEPENDENT VARIABLE (1)	Total LFPR (2)	women LFPR (3)	men LFPR (4)	black LFPR (5)	Coloured LFPR (6)	Indian/Asian LFPR (7)	white LFPR (8)
			FIRST REGIME				
Total unemployment rate	-0.029						
	(0.233)						
women unemployment rate		0.242					
		(0.364)					
men unemployment rate			-0.293***				
			(0.070)				
black unemployment rate				0.068			
				(0.317)			
Coloured unemployment rate					-0.015		
					(0.136)		
Indian/Asian unemployment rate						-0.009	
						(0.039)	
white unemployment rate							-0.061*
							(0.033)
CONSTANT	4.117***	3.099**	5.043***	3.754***	4.195***	4.104***	4.324***
	(0.750)	(1.204)	(0.219)	(1.064)	(0.426)	(0.095)	(0.054)
			SECOND REGIME				
Total unemployment rate	-0.209**						
	(0.085)						
women unemployment rate		-0.259**					
		(0.124)					
men unemployment rate			-0.059				
			(0.070)				
black unemployment rate				-0.221**			
				(0.092)			
Indian/Asian unemployment rate						-0.191***	
						(0.064)	
white unemployment rate							-0.074**
							(0.029)
CONSTANT	4.771***	4.846***	4.363***	4.817***		4.595***	4.364***
	(0.281)	(0.418)	(0.224)	(0.315)		(0.165)	(0.057)
OBSERVATIONS	53	53	53	53	53	53	53
THRESHOLD VALUE	3.247	3.357	3.149	3.401	NIL	2.542	1.808

Standard errors are in parenthesis; *** p<0.01, ** p<0.05, * p<0.1

LFPR: Labour force participation rate

5.0. Conclusion and Policy Implications

This study tested the nonlinear Unemployment Invariance Hypothesis in South Africa across race and gender. Our estimation strategy is the threshold regression developed by Hansen (2002) which enables us to ascertain whether the relationship between the unemployment rate and labour force participation rate depends on the regimes of high and low unemployment situation or rather on the business cycle (Congregado, et al. 2020). To do this, a battery of unit root tests was carried out to ascertain the stationary properties of the variables employed. According to the tests, all the variables contain unit root at level and are stationary after being first differenced; hence they are integrated of order 1. Cointegration test was further conducted using bounds testing approach to cointegration proposed by Pesaran et al. (2001). The ARDL bounds testing results showed that only Indian-Asian race and white race models have their variables cointegrated. Furthermore, in order to ascertain the linear response of the labour force participation rate to the unemployment rate and to test the validity of the Unemployment Invariance Hypothesis in South Africa, we employed the Robust Ordinary Least Squares (OLS) and Fully Modified Ordinary Least Squares (FMOLS), after which we ascertained the nonlinear relationship through the adoption of Threshold Regression of Hansen (2000). Findings from the linear model indicates a positive and significant relationship between the total unemployment rate and the total labour force participation rate, suggesting the existence of the Added Worker Effect Hypothesis (AWEH) in the aggregate data, women, males and the black race. However, our findings support the Discouraged Worker Hypothesis for the white race, but there is no significant relationship between unemployment and labour force participation for the Asian-Indian race.

The threshold regression showed that the dependence of labour force participation rate on unemployment across the different categories of players in the South African labour market is hinged on the level of unemployment rate vis-a-vis their respective threshold level. In every category of labour market players, the effect of the labour force participation rate on unemployment could either be significant or insignificant, depending on the level of unemployment rate with respect to its threshold level. Thus, we can suggest that the threshold unemployment level determines whether the Unemployment Invariance Hypothesis holds across the categories of workers in the South African labour market or not. However, the white workers in the South African labour market are different as the Discouraged Worker Effect Hypothesis holds for them irrespective of the unemployment rate, that is, prospective job seekers are discouraged from looking for work because they have been unable to find work for an extended period of time, which could be due to labour market conditions or a mismatch between the skills required by employers and the skills possessed by employees.

Given these findings, we see that the higher the unemployment rate beyond the threshold level, the higher the existence of the Discouraged Worker Effect Hypothesis in the South African labour market. As a result, a continuously high unemployment rate in the South African labour market might lead to lesser participation in the labour force, a circumstance that can exacerbate the existing unemployment problem and ultimately to permanent unemployment. The longer people stay unemployed, the more likely they are to forget the formal and informal skills they once had, making it even more unlikely that they will ever find work. Since many African nations have also agreed to implement the SDGs, including Goal 8's mandate that "by 2030, all people everywhere should have access to gainful employment in their own countries or other countries," it is imperative that their governments devise employment policies and programmes that will allow them to do so. In particular, there is a need to implement extensive labour reforms that would involve training and retraining the existing unemployed individuals,

in addition to repairing the infrastructure circumstances that have crippled many enterprises on the continent.

In conclusion, the scope of our research is limited to analysing the nonlinear relationship between the unemployment rate and labour force participation with respect to race and gender in the South African labour market. The dependence of labour force participation rate on unemployment across the different categories of players in the South African labour market is hinged on the characteristic nature of the South Africa labour market characterised by structural and cyclical unemployment, with structural disparities across race, sectors and groups. It is noteworthy that different race responded differently to the relationship between unemployment and labour force participation due to economic segmentation, institutional factors like limited social safety nets and long term mismatch between the skills of unemployed workers and available jobs. More data on the nonlinear connection between labour force participation and unemployment in other African countries could help inform policy decisions. Thus, the possible expansion of this analysis to other African countries is a suggestion for future research.

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