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IS THERE HYSTERESIS IN SOUTH AFRICAN UNEMPLOYMENT? EVIDENCE FROM THE POST-RECESSIONARY PERIOD

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ABSTRACT: High unemployment in South Africa possess as the country's most problematic economic issue faced by South African policymakers and hence is considered an overriding priority within the design of large scale government expenditure programmes. In this study, we investigate the hysteresis hypothesis for 8 categories of unemployment in South Africa using a battery of individual and panel unit root testing procedures applied to quarterly data collected in the post-recession period of 2008:q1 to 2017:q2. Indeed our empirical results confirm the hysteresis hypothesis for a majority of unemployment classifications with the exception of unemployment associated with persons aged 55 to 64 years old. Overall, our obtained empirical results hold far reaching ramifications towards domestic policymakers.

Keywords: Unemployment; Hysteresis; Unit root tests; Stationarity; tests; South Africa; Sub Saharan Africa (SSA).

JEL Classification Code: C22; C23; C51; E24.

1 INTRODUCTION

The global financial turmoil of 2007 is very commonly referred to as the worst financial crisis since the Great Depression of 1936. Having resonated via a bursting an asset bubble in the US housing market, and the subsequent closing of major investment Banks in the US during the period of 2007, the most severe repercussions of the sub-prime crisis can be summarized by two major events; the global recessionary period of 2008-2009 as well as the sovereign Euro debt crisis of 2010. In similarity to it's predecessor the Great Depression, one prominent feature of the 2009 global recessionary period was the imminent increase in unemployment rates worldwide, which has been more pronounced in the US and other Western economies. These developments have been humbling to majority of policymakers and have prompted an impulse amongst academics alike to be preoccupied with unravelling the underlying dynamics of the unemployment process in hope of avoiding a spiral of uncontrollable unemployment rates more especially over the long run.

The question regarding whether unemployment is stationary or contains hysteresis lies at the heart of the empirical debate on the underlying dynamics of the unemployment process. On one hand, stationarity implies that shocks to the unemployment process, such as those caused by the global recession period of 2009, would temporary deviate unemployment from its 'natural rate' at which it will eventually revert back to over the steady-state. Conversely, the hysteresis in unemployment implies that shocks to the variable are not transitionary but are permanent such that unemployment would not revert back to it's equilibrium in the face of exogenous shocks to the economy. Empirically, the hysteresis hypothesis is rejected if the time series found to be a levels stationary process whilst hysteresis is confirmed once a unit root is detected within the unemployment process. So if, for instance, an economy is found to exhibit hysteresis on the unemployment series, then policymakers should be aware that unemployment which arises due to recessions and other adverse shocks will be more problematic over the long run to deal with compared to the case where unemployment conforms to the natural rate hypothesis. Up-to-date, a bulk majority of the previous empirical literature has been predominantly focused on the US and other Western economies (see Brunello (1990), Roed

(1996), Leon-Ledesma (2002), Ghoshray and Stamatogiannis (2015), Marques et al. (2017)). In light of the abundance of empirical literature on the hysteresis hypothesis in the unemployment for Western economies, the absence of empirical efforts dedicated towards developing countries, and in particular African countries remains somewhat of a mystery. This is rather disconcerting since African economies are historically characterized by excessive levels of unemployment, poverty and inequality thus rendering a case study for these countries as worthwhile. The argument for the investigation into the hysteresis hypothesis for SSA countries is thus well justified and serves as a source of motivation for academics to focus more of their research efforts towards SSA countries. The obtained findings would be most welcoming towards policymakers in the SSA region in terms of their endless quest to eradicate unemployment and other social ills via strategic large scale fiscal programmes.

In our study, we examine the unemployment hysteresis hypothesis for the South African economy which is widely recognized as the most advanced country in the SSA region. Our empirical strategy involves applying a battery of individual and panel unit root tests applied to time series data of seven nationwide categories of unemployment collected in the post-crisis period of 2008 to 2017. What makes South Africa a particular interesting case study is the fact that the country is commonly dubbed as being a dual economy, in the sense of exhibiting favourable economic features such as a highly developed financial system as well as a sound fiscal system. Nevertheless, the country is currently is faced with high unemployment affecting society and its governance and this has had crippling effects on the economic welfare, production, crime, and social stability within an economy (Kingdon and Knight, 2004). In fact since the democratic elections of 1994, unemployment in the country has been unacceptably high, of which according to Banerjee et al. (2008) can be attributed to the aftereffects of the former Apartheid regime. The importance of this study to local policymakers cannot be overemphasized as the economy possess the strategic authority to battle unemployment considering that the underlying dynamics of unemployment are clearly understood.

Having provided a background and motivation for the study, the rest of the manuscript has been arranged as follows. The next section of the paper briefly provides a historical

overview of large scale government policies implemented in addressing unemployment in South Africa. The third section of the paper presents the literature review which discusses both theoretical and empirical developments in accordance with the literature. In the fourth section, we introduce the individual and panel unit root tests employed in our study are outlined. The fifth section describes the time series data and presents the empirical results based on our empirical analysis. The paper is then concluded in the fifth section of the study.

2 HISTORICAL OVERVIEW OF POLICIES DEALING WITH UNEMPLOYMENT

2.1 Reconstruction and Development Programme (RDP)

Subsequent to abolishment of the Apartheid regime and the holding of the first democratic elections in 1994, the newly elected ANC government was faced with severe social-economic problems as inherited from the former the former Apartheid government. In response to this daunting task of correcting the inherited social imbalances, the Reconstruction and Development Programme (RDP) was formulated in 1994 and represents the country's first large scale fiscal policy programme in post-democratic South Africa. The prime objectives of this programme were to provide jobs, houses, water and electricity, social welfare, health care services, nutrition, and a clean environment (Pauw et al, 2008). Part and parcel of these objectives were the attainment of a low and stable inflation rate, stability within the exchange rate and real interest rates, the promotion of domestic and foreign investment as well as the promotion of investments, small and medium business through training (Pauw et al, 2008). Concerning unemployment, the main emphasis of the programme was on the reconstruction of labour market intuitions as well as job creation through public works programmes aimed specifically at alleviating youth unemployment. However, the RDP programme was deemed unsuccessful and eventually abandoned on the premise of poor policy co-ordination and implementation methods.

2.2 Growth, employment and redistribution (GEAR) programme

In 1996 the government introduced a macro-economic plan, namely the Growth, Employment and Redistribution (GEAR) programme whose primary focus was to make the economy grow fast, be sustainable, labour-intensive, internationally competitive, attract foreign investment as well as to focus more on exports. The programme has been labelled as being neo-classical in nature and having specific macroeconomic policy objectives of improving growth, reducing inflation and the budget deficit, reforming taxation and easing the balance of payments. The underlying belief under the GEAR policy was that in order for government to achieve their ultimate goal of eradicating poverty and inequality would require the economy to attain a 6 percent GDP growth rate per annum. However, in similarity to the RDP programme, the GEAR strategy did not live up to all the expectations to increase employment. In particular, between 1996 and 2001, the economy grew by a low 2.7 per cent per annum, instead of the expected 6 per cent. On the other hand, employment levels decreased over this period, instead of increasing by 3 per cent (Van der Westhuizen et al., 2012).

2.3 Accelerated and shared growth initiative (ASGISA)

ASGISA was established in 2006 with the main aim of raising domestic growth rates and sharing the sharing the benefits of such growth in an effort to reduce inequality and poverty (Arangies *et al.,* 2008). This programmes identified areas to develop namely, women and youth, tourism sector, black economic empowerment, access to finance, investment and infrastructure development (Pauw et al, 2008). The primary objective of this policy was to reduce unemployment long-term unemployment rates with a specified target of reducing unemployment from 28% in 2004 to 14% by 2012 which was to be achieved over two planned phases. In the first phase, a period ranging between 2005 and 2009, government sought an average annual growth rate of 45 per cent. In the second phase, between 2010 and 2014, the average annual growth rate was to increase to 6 per cent of GDP (Phiri, 2017). Even though ASGISA had managed to achieve a certain level of success in terms of improved investment and a reduced government deficit, unemployment continued to grow whilst overall GDP growth declined.

2.4 New Growth Path (NGP) and National Development Plan (NDP)

Subsequent to the global recession period of 2009, two main fiscal policies were implemented and are currently the blueprint of fiscal spending programmes, those being the NGP and NDP which were both introduced in 2013. These policies programmes acknowledge and attempt to address the key problems currently facing South Africa those being high unemployment, low levels of domestic savings and investments, persistent balance of payments deficits, an overvalued exchange rate, skilled labour shortages, energy and infrastructural bottlenecks, economic concentration, government inefficiency, rent-seeking and regulatory burdens on business. In also differing from previous policy programmes, the NGP and NDP do not rely on an economic model to create jobs but create new solutions through judicious use of government policy in conjunction with private sector influences (Nattrass, 2011). Therefore the overall gist of these policies is the creation of sustainable jobs for the poor and to make the economy to be more labour intensive and efficient. In particular, the NDP has set objectives of alleviating poverty and inequality by 2030 through the creation of 10 million jobs, and this objective has come under critical criticism for being unrealistic in nature. Nevertheless, from an academic point of view the success of these programmes in influencing the unemployment rate is dependent on the evolution process of the unemployment variable.

3 LITERATURE REVIEW

3.1 Theories explaining the behaviour of unemployment

From a theoretical perspective, there are four contemporary theories which compete at explaining the evolution or behaviour of unemployment. The first of these theories is the natural rate of unemployment (NRU) hypothesis which arose courtesy of Phelps (1967) and Friedman (1968) and advocates for the existence of a constant long-run equilibrium of unemployment rates. However, in the short-run there may be non-permanent change from the long-run equilibrium. Thus, this hypothesis proposes that the unemployment rate is a constant and stationary process which may exert short-term shocks. According to Phelps (1967) and

Friedman (1968) there are certain factors that have an effect on the natural rate of unemployment. On the supply side of the labour market these factors include; differences in age, gender, and race of the labour force. On the demand side of the labour market, differential job creation and changes in industry technologies have an effect on natural rate of unemployment.

The second theory is the structuralist hypothesis as formalized by Phelps (1994), this theory shows that any changes in fundamentals may change the level of unemployment over a period of time. In line with this theory, unemployment rate is a consistent process subject to occasional but continuing structural changes. In structuralist models, movements in the rate of unemployment are regarded as movements around the NRU and the steady increase in unemployment is the result of a combination of constant shocks that increased the NRU (Raurich et al., 2006).

The third theory of unemployment found in the literature is the persistence theory mainly attributed to the works of Hall (1975) who argue for a slow speed of change in relation to the long run equilibrium unemployment rate after a shock. Thus, according to the theory the unemployment rates are characterised by a constant long memory process (Ayala, *et al.,* 2006). The second definition explaining the persistent hypothesis is the insider-outsider theory. This theory is explaining the loss of the influence on setting wages. The inside workers have power in determining wages in the economy. This market power that the insiders have makes it expensive for firms to employ the outsiders (unemployed workers). Unions also have market power in determining wages (Neudorfer et al., 1990).

The final theory explaining the evolution of the unemployment process is the hysteresis hypothesis, as developed by Blanchard and Summers (1986) which describes unemployment as a nonstochastic variable that never returns to equilibrium after a shock. Thus, under this theory short-term shocks to unemployment exert permanent effects over the steady-state long-run, such that a sharp increase of unemployment, if left by itself, may continue to be a problem in the economy even in the long run (Song and Wu, 1998). Hence, from a policy perspective,

hysteresis indicates that recessions are much more expensive to the government than the natural rate hypothesis of unemployment would suggest. The theoretical foundations for this theory can be traced to unemployment models built on the premise of existing labour unions, insiders' bargaining power, worker protection laws as well as the occurrence of human capital depreciation during unemployment periods (Guris et al., 2017).

3.2 Review of empirical literature

3.2.1 The literature for advanced economies

As mentioned in the introduction, a bulk majority of the existing literature are studies conducted for advanced countries. Having conducted an exhaustive review of the existing literature, we find that the studies of Brunello (1990) for Japan; Jaeger and Parkinson (1994) for Canada, Germany, US and UK; Roed (1996) for 16 OECD countries; Song and Wu (1997) for the US; Song and Wu (1998) for the 15 OECD countries; Leon-Ledesma (2002) for the US and 21 EU countries; Smyth (2003) for 8 Australian territories; Mitchell (2003) for 18 OECD countries; Camarero and Tamarit (2004) for 19 OECD countries; Camarero et al. (2006) for 19 industrialized countries; Gustavsson and Osterholm (2005) for 5 industrialized economies; Lee (2010) for 29 OECD countries; Lanzafame (2010) for Italy; Chang (2011) for 17 OECD countries; Huang (2011) for 14EU and 14 OECD countries; Fosten and Ghoshray (2011) for 6 OECD countries; Cheng et al. (2012) for the US; Liu et al. (2012) for Australia; Lee et al. (2013) for 12 OECD countries; Bakas and Papapetrou (2014) for Greece; Garcia-Cintado et al. (2015) for Spain; Ghoshray and Stamatogiannis (2015) for the UK and US; Klinger and Weber (2016) for the US and Germany; and Marques et al. (2017) for 28 OECD countries, suffices as an exhaustive list of relevant works.

We note that a majority of these studies are panel studies (i.e. Brunello (1990); Jaeger and Parkinson (1994); Roed (1996); Song and Wu (1998); Leon-Ledesma (2002); Mitchell (2003); Camarero and Tamarit (2004); Camarero et al. (2006); Gustavsson and Osterholm (2005); Lee (2010); Chang (2011); Huang (2011); Fosten and Ghoshray (2011); Lee et al.

(2013); Ghoshray and Stamatogiannis (2015); and Marques et al. (2017)) which utilize a wide range of individual and panel unit root testing procedures. Notably, all reviewed panel studies for industrialized economies confirm hysteresis in unemployment even though there are a handful exceptional case studies which find mixed evidences between hysteresis and the natural rate hypothesis (Camarero and Tamarit (2004); Camarero et al. (2006); Gustavsson and Osterholm (2005); Lee (2010); Lee et al. (2013)). However, concerning country specific studies (Brunello (1990); Song and Wu (1997); Smyth (2003); Lanzafame (2010); Cheng et al. (2012); Liu et al. (2012); Bakas and Papapetrou (2014); Garcia-Cintado et al. (2015)) the hysteresis appears to be more pronounced when researchers investigate the hypothesis for regions within specific countries (Song and Wu (1997); Smyth (2003); Liu et al. (2012); Bakas and Papapetrou (2014); Garcia-Cintado et al. (2015)). A summary of the reviewed studies for industrialized economies is provided in Table 2.

Table 2: Summary of reviewed literature (industrialized economies)

Author	Country/Countries	Time	Methodology	Results
Brunello (1990)	Japan	1955-1987	ADF unit root tests	Hysteresis in unemployment
Jaeger and Parkinson (1994)	Canada, Germany, US and UK	1961-1991	Unobserved components model	Hysteresis in unemployment for all countries except the US.
Roed (1996)	16 OECD countries	1970-1994	ADF unit root tests	Hysteresis in unemployment in all countries with the exception of the US.
Song and Wu (1997)	48 U.S. states	1962-1993	Univariate and panel based ADF, PP, ZA tests	Univariate tests find hysteresis in individual states whereas panel tests find no hysteresis.
Song and Wu (1998)	15 OECD countries	1960-1992	ADF and PP unit root tests	Hysteresis in unemployment in all countries.
Leon-Ledesma (2002)	51 US states and 21 EU countries	1985-1999	IPS panel unit root test	Hysteresis in unemployment in both US and EU countries.
Smyth (2003)	8 Australian territories/states	1982-2002	ADF, LLC and IPS panel unit root tests	Hysteresis in unemployment in all territories/states.
Mitchell (2003)	18 OECD countries	1960-1991	ADF and PP test with structural break	Hysteresis in unemployment
Camarero and Tamarit (2004)	19 OECD countries	1998-2001	MADF and SURADF	7 of the 19 OECD countries have hysteresis in unemployment.
Gustavsson and Osterholm (2006)	Australia, Canada, Finland, Sweden and the US	1960-2005	Kapetanois et al. (2003) nonlinear unit root tests	Unemployment is stationary in all countries except Australia
Camarero et al. (2006)	19 OECD countries	1956-2001	IPS, MW, KPPS, Hadri, CiS tests	Hysteresis hypothesis is rejected once structural breaks are accounted for

Lee (2010)	29 OECD countries	1960-2008	Linear and nonlinear panel unit root tests.	Linear unit root test show hysteresis in 23 of the 29 countries and nonlinear unit root tests show hysteresis in 6 of 29 countries.
Lanzafame (2010)	Italy	1977-2003	MP and BC structural break tests	No Hysteresis in Italian unemployment.
Chang (2011)	17 OECD countries	1960-2009	Unit root tests with Fourier function.	Hysteresis in 11 of 17 countries.
Huang (2011)	14EU and 14 OECD countries	1975-2009	IPS and NH panel unit root tests	Hysteresis in unemployment in both panels
Fosten and Ghoshray (2011)	6 OECD countries	1750-2005	LKT tests	Depending on timeframe regime unemployment can display hysteresis or not
Cuestas et al. (2011)	8 CEE countries	LS	LS and BBC tests	Unemployment is stationary but very persistent
Cheng et al. (2012)	US	1976-2010	Recursive mean adjustment (RMA)	US unemployment is stationary with long half lives
Liu et al. (2012)	8 Australian territories/states	1982-2010	ADF, PP, KPPS, LLC; IPS. MW, Hadri, CiS tests	Mixed results with univariate tests but hysteresis in panel unit root tests.
Lee et al. (2013)	12 OECD countries	1960-2010	Quantile covariate unit root tests	Unemployment is globally stationary although there is some evidence of hysteresis in upper quantiles.
Bakas and Papapetrou (2014)	13 regions in Greece	1998-2011	ADF, DF-GLS, LLC, IPS, MW, Hadri, MADF.	Hysteresis in all Greek regions
Garcia-Cintado et al. (2015)	17 Spanish regions	1976-2014	LP and LS unit root tests with structural breaks.	Hysteresis in Spanish unemployment.
Ghoshray and Stamatogiannis (2015)	UK and US	1750-2002	KPZ test	Switching dynamics from natural rate to hysteresis
Klinger and Weber (2016)	US and Germany	1960-2015	M-S unobserved components	Hysteresis in US data but not Germany
Marques et al. (2017)	28 OECD countries	2000-2014	DF-GLS and PR tests	Hysteresis in OECD unemployment rates after the global recession on 2009.

Note: ADF – augmented dickey fuller tests; PP – Phillips and Perron tests, DF-GLS – Elliot et al. (1996) test, NP – Ng and Perron tests; LS – Lee and Strazicich (2003) tests; BBC – Bec et al. tests; ZA – Zivot and Andrew structural break test; M-S – Markov Switching; KPZ – Kejriwal et al. (2013) tests; MW – Maddala and Wu (1998) tests; IPS – Im et al. (2003) tests; CiS – Carrion-i-Silvestre et al. (2005) test; LLC - Levin et al. (2002) tests; MP - Murray and Papell (2000); BC – Breitung and Candelon (2005); MADF – Multivariate augmented Dickey-Fuller test; SURADF – seemingly unrelated regressions augmented Dickey-Fuller test; LKT – Leybourne et al. (2007) test; PR – Perron and Rodriguez (2003) test.

3.2.2 The literature for emerging and developing economies

The literature concerning developing countries is not as extensive as is the case for industrialized economies and be summarized through the works of Leon-Ledesma and McAdam (2002) for 12 CEE countries; Chang et al. (2007) for Taiwan; Camarero et al. (2008) for 8 CEE countries; Gomes and da Silva (2008) for Brazil and Chile; Mednik et al. (2010) for 13 Latin American countries; Cuestas et. al. (2011) for 8 CEE countries; Ayala (2012) for 18 Latin American countries; Furuoka (2012) for 12 East-Asian-Pacific countries; Chang and Su (2014) for Taiwan; Furuoka (2015) for 5 Estonian regions; and Olanipekun et al. (2017) for South Africa and Nigeria. One again we note that a majority of the available literature are panel studies (Camarero et al. (2008); Gomes and da Silva (2008); Mednik et al. (2010); Cuestas et. al. (2011); Ayala (2012); Furuoka (2012); Furuoka (2015) and Olanipekun et al. (2017)) which tends to argue for at least a very persistent unemployment process although exceptional cases exist for countries like Nigeria which has established to have stationary unemployment rates. Similarly, for the country-specific studies, Chang et al. (2007) for Taiwan; Chang and Su (2014) for Taiwan; Furuoka (2015) for 5 Estonian regions; the natural rate hypothesis tends to be reject in favour of either a very persistent or non-stochastic unemployment process. The review of studies for non-industrialized economies has been conveniently summarized in Table 3.

Table 3: Summary of reviewed literature (non-industrialized economies)

Author	Country/Countries	Time	Methodology	Results
Leon-Ledesma and McAdam (2004)	12 Central and Eastern European countries	1991-2001	ADF, KPSS, DF-GLS individual unit root tests and IPS, Chang and Taylor-Sarno panel unit root tests.	Reject hysteresis hypothesis after controlling for structural breaks.
Chang et al. (2007)	Taiwan	1993-2001	ADF, PP, DF-GLS, LLC, IPS and MADF	ADF, PP and DF-GLS find hysteresis whereas LLC, IPS and MADF tests reject hysteresis.
Camarero et al. (2008)	8 CEE economies	1991-2003	IPS, MW, KPPS, Hadri, CiS tests	Hysteresis in unemployment in all countries
Gomes and daSila (2008)	Brazil and Chile	1982-2004	LS	Unemployment is highly persistent on both countries although hysteresis accounts to small portion of unemployment evolution

Mednik et al. (2010)	13 Latin American countries	1980-2005	ADF, KPPS, IPS and CiS tests	Hysteresis in most countries
Cuestas et al. (2011)	8 CEE countries	LS	LS and BBC tests	Unemployment is stationary but very persistent
Ayala et al. (2012)	18 Latin America countries	1970-2009	ADF, LS (2004) one structural and LS (2003) two-structural breaks.	For ADF, unemployment in 17 of 18 countries have unit root, for LS (2004) hysteresis in 9 of 18 countries, LS (2003) hysteresis in 2 of 18 countries.
Furuoka (2012)	12 East-Asia-Pacific countries	1980-2009	MADF and SURADF tests	Hysteresis in unemployment.
Chang et al. (2014)	Taiwan	1978-2012	LLC, IMPS, MW, Peseran, Moon and Perron, Bai and Ng and Choi	All unemployment series contain hysteresis with the exception of college degree holders.
Furuoka (2015)	5 Estonian regions	1993-2011	IPS	No hysteresis in unemployment rates.
Olanipekun et al. (2017)	South Africa and Nigeria	1991-2015	ZA	Hysteresis in South Africa unemployment but not Nigeria

Note: ADF – augmented dickey fuller tests; PP – Phillips and Perron tests, DF-GLS – Elliot et al. (1996) test, NP – Ng and Perron tests; LS – Lee and Strazicich (2003) tests; BBC – Bec et al. tests; ZA – Zivot and Andrew structural break test; M-S – Markov Switching; KPZ – Kejriwal et al. (2013) tests; MW – Maddala and Wu (1998) tests; IPS – Im et al. (2003) tests; CiS – Carrion-i-Silvestre et al. (2005) test; LLC - Levin et al. (2002) tests; MP - Murray and Papell (2000); BC – Breitung and Candelon (2005); MADF – Multivariate augmented Dickey-Fuller test; SURADF – seemingly unrelated regressions augmented Dickey-Fuller test; LKT – Leybourne et al. (2007) test; PR – Perron and Rodriguez (2003) test.

4 METHODOLOGY

As should be clear to the reader by now, unit root tests are the norm for investigating the hysteresis hypothesis within the unemployment rates. In order to assume robustness of empirical results, researchers tend to investigate the intergration properties of the unemployment process using a batter of unit root tests. In our study, we follow in pursuit by applying a combination of individual unit root tests and panel unit root tests to conduct our empirical analysis. In particular, we shall be using the individual unit root tests of ADF, PP, KPPS, DF-GLS and Ng-Perron procedures as our sample of individual unit root tests. On the

other hand, our panel tests will consist of the tests of Levin et al (2000) (LLC) test; Hadri's (2000) unit root test; Im et al. (2003) (IPS) test, Breitung's (2000) test and Fischer type-tests (Maddala and Wu, 1999). The testing procedures are discussed in the following sub-sections of the paper.

4.1 Individual unit root tests

The augmented Dicey Fuller (ADF) test is the most used method for testing the integration properties of a time series. Given an unemployment time series, $unemp_t$, and denoting Δ as the first difference operator, the ADF test regression assumes the following form:

$$\Delta unemp_t = \beta' T_t + \alpha_i\, unemp_{t-1} + \sum_{i=1}^{p} \psi\, \Delta unemp_{t-p} + e_t \qquad (1)$$

Where D_t contains deterministic components (constant or constant plus time trend) and e_t is a well-behaved error term. The unit root null hypothesis of the time series is tested as $\alpha_i = 0$ and this is tested against the alternative hypothesis of a stationary process (i.e. $\alpha_i < 0$). However the ADF test has been criticized for it's determination of lag length p in the regression, of which not suitably chosen will results in biased results. Therefore, the PP unit root test can be used as an alternative to eliminate the asymptotic basis found in the ADF test, by relying on the following test regression:

$$unemp_t = B'D_t + \alpha_i\, unemp_{t-1} + e_t \qquad (2)$$

Where in similarity to the ADF test, the nonstationary null hypothesis is tested as $\alpha_i = 0$ against the stationary alternative of $\alpha_i < 0$. Nevertheless, both ADF and PP unit root test produce low testing power when attempting to distinguish between near-stationary and pure nonstationary processes. The DF-GLS test of Elliot et al. (1996) proposes the de-trending of the time series before applying the unit root testing procedures. Denoting the de-trended unemployment time series as unemp*, the DF-GLS test regression can written as:

$$\Delta unemp^*_t = B'D_t + \alpha_i\, unemp^*_{t-1} + \sum_{i=1}^{p} \alpha\, \Delta unemp^*_{t-1} + u_t \quad (3)$$

And the unit root null hypothesis is once again tested as $\alpha_i = 0$ against the stationary alternative (i.e. $\alpha_i < 0$). Note that when the DF-GLS tests is performed with an intercept, the t value is the same as the t value of the ADF test. These two tests will have the same critical value. When DF-GLS test has both trend and intercept, the distribution is different from the ADF test and the critical value will be the same as of the ERS test. Perron and Ng (1996, 2001) take from Elliot et al. (1996) by de-trending the time series and creating four different statistics corresponding via Monte Carlo simulations, to produce efficient versions of both PP and ADF test statistics. The resulting tests statistics are denoted as MZ, MZt, MSB and MPT.

Whilst the aforementioned tests (i.e. ADF, PP, DF-GLS and Perron-Ng tests) are built on the notion of testing the unit root null hypothesis, Kwiatkowski et al. (1992) present a test of the null hypothesis of stationarity against the alternative hypothesis of nonstationary. The so-called stationary test takes the following functional form:

$$unemp_t = \beta' D_t + \mu_t + u_t, \quad (4)$$

$$u_t = \mu_{t-1} + \varepsilon_t, \quad N(0, \sigma_e^2) \quad (5)$$

Where the null hypothesis of a stationary process is tested as $\sigma_e^2 = 0$ and this is tested against the alternative of a unit root process in the time series.

4.2 Panel based unit root tests

Panel-based unit root test has become a very popular since the use of panel time series increase the explanatory power of the tests given that more observations are generally observed

in these types of tests. In our study employ five panel based unit root testing procedures, Levin et al (2000) (LLC) test; Hadri's (2000) unit root test; Im et al. (2003) (IPS) test, Breitung's (2000) test and Fischer type-tests (Maddala and Wu, 1999). Whilst the first two tests assume a common unit root process in the test regression, on the other hand, the Im et al. (2003), Breitung's (2000) test and Fisher type tests are panel test with individual unit root process. Begining with the LLC test which is basically a panel extension of the ADF test and tests the following regression:

$$\Delta unemp_t = \beta' T_t + \alpha_i\, unemp_{t-1} + \sum_{i=1}^{p} \psi\, \Delta srunemp_{t-1} + X'_{it}\delta + u_t \qquad (6)$$

Where we assume a common α_i, but allow the lag order for the difference terms, p_i, to vary across cross-sections. As with the case of the ADF test, the unit root null hypothesis is tested as $\psi_i = 0$ against the stationary alternative of $\psi_i < 0$. Conversely, Hadri's (2000) tests is a panel extension of the KPSS tests in the sense of testing the null hypothesis of a stationary process against the nonstationary alternative. The test regression can specified as:

$$unemp_{it} = \delta_i + \eta_i t + e_{it} \qquad (7)$$

Where the null hypothesis of a stationary process can be tested as $\sigma_\mu = 0$. In differing from the LLC and Hadri tests, The IPS test assumes heterogeneity in each dynamic panel and thus corrects for and observed autocorrelation in the test regression. The test can be represented in the following regression:

$$\Delta unemp_{it} = \alpha_i\, unemp_{i,t-1} + z_{it}\, \lambda_t + e_{it} \qquad (8)$$

Where α_i is panel specific. Thereafter the null hypothesis of a unit root existing in each individual series is tested as $\alpha_i = 0\ \forall_i$, which is tested against the alternative of an otherwise stationary process. Breitung (2000) built upon the IPS test by constructing a pooled panel unit root test that does not require bias correction of the variables by suggesting the transformation of the test regression regressions by forward orthogonalization (i.e. e^*_{it}), then the following regression is run:

$$e^*_{it} = \alpha\ v_{i,t-1} + u_{it} \quad (9)$$

Where the unit root null is tested as $\alpha = 0$ against the stationary alternative. Finally, the Fisher type tests employ the p-values from each unit root tests for each cross section. In particular, Madala and Wu (1999) propose that by defining pi as the p-values from the individual ADF tests regressions, then the asymptotic results derivation is as follows:

$$p = -2\ \sum_{i=1}^{N} \ln pi \quad (10)$$

While maintaining the proposition that the null hypothesis of a unit root process is tested against the alternative of stationary process.

5 DATA AND EMPIRICAL RESULTS

5.1 Data description

The time series data used in our study consists of seven different demographic categories of unemployment for South Africa, namely; males, females, ages 15 and above, ages

15 to 24, ages 15 to 64, ages 25 to 54 and ages 55 to 64, and has been collected been the first quarter of 2008 up to the l first quarter of 2017. The specific details of the collected series are reported in Table 2. The specific details of the collected series are reported in Table 2. Furthermore, Table 3 presents the summary statistics of the time series variables and reveals a number of noteworthy preliminaries. For instance, we note that the mean values are higher for females at 27.18 when compared to male unemployment rates which are averaged at 22.86. For the case of age groups, persons aged between 15 to 24 years old exert the highest mean values at 54 percent in the post-recession period. This particular finding places emphasis/reflects the severity of youth unemployment in the country which is reputable for being amongst the highest globally. Unsurprisingly, the lowest unemployment averages are established for persons aged between 55 and 64 years.

Table 2: Data collection and source

Series	Symbol	Frequency	Time period	Source
Unemployment rate: Age 15 and over for males	Males	Quarterly, seasonally adjusted	2008:q1 – 2017:q2	FRED database
Unemployment rate: Age 15 and over for females	Females	Quarterly, seasonally adjusted	2008:q1 – 2017:q2	FRED database
Unemployment rate: Aged 15 and above	15 and above	Quarterly, seasonally adjusted	2008:q1 – 2017:q2	FRED database
Unemployment rate: Aged 15-24	15-24	Quarterly, seasonally adjusted	2008:q1 – 2017:q2	FRED database
Unemployment rate: Aged 15-64	15-64	Quarterly, seasonally adjusted	2008:q1 – 2017:q2	FRED database
Unemployed rate: Aged 25-54	25-54	Quarterly, seasonally adjusted	2008:q1 – 2017:q2	FRED database
Unemployed rate: Aged 55-64	55-64	Quarterly, seasonally adjusted	2008:q1 – 2017:q2	FRED database

Table 3: Summary statistics of time series

	males	females	15 and above	15-24	15-64	25-54	55-64
Mean	22.86	27.18	24.81	50.46	24.82	21.91	7.51
Median	23.10	27.20	24.90	50.90	25.00	21.90	7.60
Maximum	25.40	29.50	27.30	54.00	27.70	25.10	10.50
Minimum	19.50	25.20	22.40	44.40	21.50	18.80	5.20
Std.dev.	1.43	1.07	1.20	2.32	1.30	1.48	1.22
JB	4.76	0.68	0.58	4.26	0.32	0.36	1.38
p-value	0.09	0.71	0.75	0.12	0.85	0.84	0.50

Figure 1: Time series plots of unemployment rates (2008-2017)

5.2 *Empirical estimates*

Table 2 below reports the results of the individual unit root test, as performed with i) an intercept and ii) a trend on the levels for each of the six categories of unemployment in South Africa. In quickly scrutinizing through the time series we find that each of the time series

generally fails to accept the notion of stationarity within the time series. In particular, when all unit root tests are performed with only an intercept then the unit root hypothesis is rejected across all the time series variables at all critical levels; that is with the sole exception of the KPSS test which fails to reject the stationary null hypothesis for persons aged 25 to 54 and 55-64 years old. However, when the test are performed with a trend, then the results become more ambiguous more prominently so for the KPPS test. Note that the test statistics produced for the KPPS test when performed with a trend fail to reject the stationarity process for all examined time series except for person aged 15-24, 25-54 and 55-64. Other notable results include the rejecting of the unit root null hypothesis for persons aged 55-64 years for the ADF, PP, DF-GLS, Ng-Perron tests when performed with a trend. Furthermore, the findings of a unit root process in unemployment for persons gaged 15 to 64, when both PP and Ng-Perron tests are performed with a trend are rather ambiguous findings since they do not confirm to majority of the results obtained from the other unit root tests.

Table 4: Individual unit root tests (levels)

		males	females	15 and above	15-24	15-64	25-54	55-64
ADF	intercept	-1.88	-0.38	-0.69	-2.10	-1.23	-2.10	-1.02
	trend	-2.43	-1.90	-1.78	-2.46	-1.86	-2.46	-4.35***
PP	intercept	-1.48	-0.50	-0.69	-2.00	-1.71	-2.00	-1.67
	trend	-2.28	-2.06	-1.94	-2.39	-4.10**	-2.39	-4.26***
KPSS	intercept	0.68**	0.63**	0.69**	0.57**	0.68**	0.57	0.65
	trend	0.10	0.09	0.10	0.14**	0.10	0.14*	0.16**
DF-GLS	intercept	-0.48	-0.24	0.09	-1.04	-0.37	-1.05	-1.17
	trend	-2.08	-1.92	-1.86	-2.29	-2.75	-2.30	-4.03***
Ng-Perron (intercept)	MZa	0.11	-0.33	0.87	-1.78	1.90	-1.78	-2.58
	MZt	0.05	-0.14	0.43	-0.71	1.08	-0.71	-0.78
	MSB	0.47	0.42	0.50	0.40	0.57	0.40	0.30
	MPT	18.17	14.50	22.26	10.74	30.93	10.74	8.10

Ng-Perron (trend)	MZa	-6.29	6.21	-6.13	-7.52	-60.21***	-7.52	-14.97*
	MZt	-1.76	-1.69	-1.70	-1.94	-5.45***	-1.94	-2.60
	MSB	0.28	0.27	0.28	0.26	0.09***	0.26	0.17*
	MPT	14.49	14.63	14.82	12.12	1.68***	12.12	6.85

Note: * denotes 10% significance level, ** denotes 5% significance level, *** denotes 1% significance level

In now turning to the results of the individual unit root tests as performed on the first differences of the time series, we find a complete reversal of the empirical results in the sense that a majority of the time series confirm stationarity within the differenced time series. As can be easily observed the ADF, PP, DF-GLS and Ng-Perron test all reject the unit root null hypothesis at all levels of significance whereas the results from the KPSS and Ng-Perron tests are not so conclusive for all the time series variables. In particular, we note that when the KPSS is performed with a trend and the Ng-Perron is performed with an intercept on unemployment rates for persons aged 15 to 64 years old, the unit root hypothesis cannot be rejected at all levels of significance. Other exceptional cases arise concerning unemployment for persons aged 55 to 64 years old, when the KPSS tests are performed with either an interceptor a trend as well as for the MZt and MPT statistics of the Ng-Perron tests performed with a trend, as the aforementioned tests cannot reject the unit root null hypothesis at all critical levels. However, in collectively taking into consideration that fact that a majority of the reported tests statistics point to stationarity in all observed time series in their first differences. We are thus obliged to conclude that the individual unit root test statistics point to all unemployment series being I(1) variables.

Table 5: Individual unit root tests (first differences)

		males	females	15 and above	15-24	15-64	25-54	55-64
ADF	intercept	-7.10***	-5.16***	-5.95***	-6.21***	-6.95***	-7.61***	-8.74***
	trend	-7.03***	-5.11***	-5.84***	-6.27***	-6.83***	-7.48***	-8.82***
PP	intercept	-7.10***	-5.12***	-5.95***	-6.27***	-22.10***	-7.78***	-9.56***

	trend	-7.03***	-5.06***	-5.84***	-6.42***	-22.07***	-7.63***	-9.86***
KPSS	intercept	0.10	0.11	0.09	0.14	0.19	0.12	0.43*
	trend	0.09	0.06	0.08	0.10	0.16**	0.11	0.50***
DF-GLS	intercept	-6.23***	-4.59***	-4.76***	-5.50***	-1.79*	-6.72***	-8.53***
	trend	-6.91***	-5.19***	-5.66	-5.83***	-5.03***	-7.54***	-8.55***
Ng-Perron (intercept)	MZa	-17.28***	-16.37***	-16.48***	-17.16***	-0.66	-17.06***	-14.16***
	MZt	-2.94***	-2.86***	-2.87***	-2.87***	-0.38	-2.91***	-2.44**
	MSB	0.17***	0.17**	0.17**	0.16***	0.57	0.17***	0.17***
	MPT	1.42***	1.15***	1.49***	1.63***	20.03	1.46***	2.54**
Ng-Perron (trend)	MZa	-16.81*	-17.15***	-17.10*	-17.18***	-59.25***	-16.21*	-14.51*
	MZt	-2.89*	-2.89***	-2.90*	-2.91***	-13.40***	-2.82*	-2.55
	MSB	0.17*	0.17*	0.17*	0.17*	0.03***	0.17*	0.17*
	MPT	5.45**	5.53*	5.45**	5.41**	0.26***	5.79*	7.10

Note: * denotes 10% significance level, ** denotes 5% significance level, *** denotes 1% significance level

Table 6 presents the panel unit root tests as performed on the levels and first differences of our observed time series. Starting with the results obtained from the tests performed on the levels of the variables, we find results similar to those obtained from the individual unit root tests in the sense of a majority of test statistics failing to reject the unit root hypothesis at all critical levels for all panel unit root tests. In particular, the results from the common root unit root tests (i.e. the LLC and Breitung's tests) manage to reject the unit root null hypothesis at all levels of significance regardless of whether the tests are performed with an intercept a trend. However, the results associated with the individual root unit root tests (i.e. IPS, ADF-Fisher, PP-Fisher and Hadri tests) are less conclusive, as when the ADF-Fisher and PP-Fisher tests performed with a trend, the test statistics reject the unit root hypothesis, at 10 and 5 percent critical levels respectively, in favour of stationarity within the time series. On the other end of the spectrum, when the panel unit root tests are performed on the first differences of the variables, our produced test statistics mutually reject the unit root hypothesis at all significance levels with the sole exception of the Hadri test performed with a trend in which we find that

the stationarity null is rejected at all critical levels. Nevertheless, given the overriding evidence of unit roots in the levels and stationary series in the first differences, we are compelled to accept the hysteresis hypothesis for South African unemployment rates.

Table 6: Panel unit root tests on time series

		levels	first difference
COMMON ROOT TESTS			
LLC	intercept	0.22	-15.75***
	trend	-1.02	-14.48***
Breitung	Intercept and trend	-0.88	-7.01***
INDIVIDUAL ROOT TESTS			
IPS	intercept	1.06	-15.78***
	trend	-1.63	-14.76***
ADF-Fisher	intercept	7.41	184.16***
	trend	22.49*	166.97***
PP-Fisher	intercept	8.13	179.04***
	trend	26.08**	425.31***
Hadri	intercept	8.43***	-0.08
z-stat	trend	3.71***	2.97***

Note: * denotes 10% significance level, ** denotes 5% significance level, *** denotes 1% significance level

6 CONCLUSION

Since the democratic elections of 1994, unemployment remains the most problematic economic issue faced by South African policymakers and hence is considered an overriding priority within the design of large scale government expenditure programmes. In this regards,

an important empirical question that can be posed towards policymakers is whether unemployment contains hysteresis or conforms to the natural rate hypothesis. Primarily motivated by the increase trend in domestic unemployment rates as experienced subsequent to the global recession period of 2009, this current study has been concerned with investigating the hysteresis phenomenon for 8 different categories of unemployment data for South Africa collected between 2008:q1 and 2017:q2. To this end, we apply a battery of individual and panel unit root testing procedures to investigate the integration properties of the unemployment process.

Our obtained empirical results indicate that there are slight discrepancies concerning the results obtained from the individual unit root tests, with unemployment being predominantly nonstationary for all sexes and age groups with the exception of unemployment associated with persons aged between 55 to 64 years old. On the other end, the panel results more convincingly confirmed hysteresis in South African unemployment rates for South Africa for periods subsequent to the 2009 recession period. All-in-all, there are some important policy implications which can be derived from our empirical study. For starters, the general confirmation of hysteresis in the unemployment process for South African data implies that shocks to the unemployment rate will not revert to an existing natural rate equilibrium. To recall, the hysteresis hypothesis implies that government intervention is necessary to reduce unemployment. Therefore the current NGP and NDP policy programmes are applauded but yet it can be questioned as to whether government intervention is continuously required to keep unemployment at a manageable level. The fact of the matter is that it is possible that unemployment evolves as an asymmetric process, being stationary between certain levels and turning nonstationary at other levels. The empirical confirmation of such possibility of such asymmetric can be left for future endeavour.

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