OKUN'S LAW REVISITED: EVIDENCE FROM NIGERIA (1980-2014)

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Abstract

This paper analyzes the applicability of Okun's law to the Nigerian economy. Analysis of Okun's law serves as an interesting case study due to the noticeable high level of unemployment rate as well as high growth in Nigeria. Using annual time series data over the period 1980–2014, the study uses Okun on both the difference and the gap models originally postulated by Okun's . The study employs Augmented Dickey Fuller test to determine and inverse root and found out that the data employed are unit root free and the (VAR) equation is stable (stationary). However, the results obtained from VAR Granger Causality/Block Exogeneity Wald Tests show that individually and collectively there is no granger causality between GDP growth and unemployment rate. The results from impulse response of economic growth to unemployment display lack of linkage between the two macroeconomic variables in Nigeria. The results from robust OLS suggest positive relationship without any level of significance. The results based on the two models and from the three empirical outputs suggest economic growth does not explain the unemployment problem in Nigeria. The study therefore concludes that Okun's law is not valid for Nigeria.

Keywords: Okun's law; Unemployment; GDP growth; Nigeria

1 Introduction

Fifty-Four years ago, Arthur Okun (1962) published a work titled: Potential GNP: its measurement and significance. Okun argues in this study that one major determinant of economic growth is the level of employment. He explains that, since the level of economic activities depends on the quantity of labour engaged in the economy, it naturally follows that an increase in output should be followed by an increase in labour demand, which can either come through the engagement of new workers or making existing employees put in extra hours of work, hence increase in economic output. Consequently, Okun hypothesizes that one-percent point change in the unemployment rate is associated with an approximately three- percent change in economic growth in the opposite direction. This observed negative short-run relationship between unemployment and output is described as a staple of macroeconomic textbooks (Blanchard & Fischer, 1989). Blinder (1997) describes it as a useful model, Mankiw (2012) and Romer (2012) refer to it as a truly sturdy empirical regularity that constitutes part of the core of practical macroeconomics that should be celebrated.

Several empirical studies have been carried out to either validate or refute the Okun regularity. Gordon (1984); Hamada and Kurosaka (1984); Kaufman, (1988); Prachowny (1993) and Weber (1997) for instance generally accepted the empirical regularity that predicts 3 percentage point increase in output for every 1 percentage point reduction in the

unemployment rate. Meanwhile, one striking observation is the fact that economies of countries have passed through structural changes which might have raised challenges to the 3 to 1 ratio as an empirical regularity. Based on these structural changes, Sawtell (2007); Ball and Loungani (2013) in the US in Japan, Lancaster and Tulip (2015), Valadkhani (2015) in Australia Villaverde and Maza (2009), Melguizo (2015) in Spain, Moosa (1997) in G7 countries, Attfield and Silverstone (1998) in UK, Sögner (2001), in Austria, Sögner and Stiassny (2002), Kargi (2015), Dixon, Lim and Ours (2016) in OECD countries and Cavusoglu (2015) Marth (2015) in European countries have all attested to Okun's Law validity. Sawtell (2007), for instance offers insight into the jobless recovery phenomenon experienced in the U.S. economy by examining industry-sector employment responsiveness to the long-term real GDP expansion occurring during 1991-2001 and still found negative and significant output-employment elasticities across industry categories.

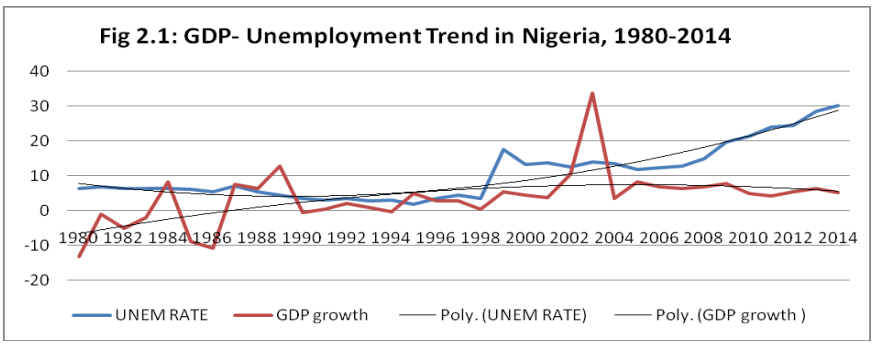
It can be observed that despite the significant attention given to Okun's Law, the bulk of empirical literature still drew conclusion from U.S, Europe and other advanced countries data without focusing on less developed economies like Nigeria knowing full well that the period following 1980s (especially before the 1986 SAP period) persistently witnessed high joblessness and low output growth at the same time. Nigeria economic growth trajectory in the last decade has been very salutary as real output grew at an average of 6.22 percent between 2005 and 2014, peaking at 7.8 per cent in 2009 (CBN, 2015), although with a 19.9 percent average in unemployment rate for the same period. The recorded economic expansion usually creating good news for jobseekers while at the same time leaving them unemployed raises two serious questions for economic analysts and policymakers. First, is the expansion in the rate of economic growth inconsistent with the Okun's empirical regularity in Nigeria? If so, this would have important implications for competing hypothesis that have attempted to explain Okun's Law in Nigeria without taking into cognizance the post-2000 economic expansion. Although the empirical work of Arewa and Nwakanma(2012), Bankole and Fatai (2013) and Akeju and Olanipekun (2014) in this regard can be considered recent, this researcher however observed substantial disparity in their results. While Akeju and Olanipekun (2014) for instance employed difference version and found that Okun's law is applicable to Nigeria, Bankole and Fatai(2013) adopted the gap model and found otherwise. One major possible reason for the contrary conclusion might not be unconnected with the fact their study is too partial by focusing only on one of the two models. Meanwhile Dasgupta and Singh (2005), Sawtelle (2007) and Tregenna (2008) argue that before any analysis between unemployment and economic growth can be considered robust both the difference and the gap models must be tested.

Taking into cognizance the partial analysis of the earlier studies, this paper revisits the empirical analysis of Okun's Law while determining whether the economic contractions and expansions witnessed in Nigeria from 1980 to 2014 is in line with the bedrock assumption or is seriously challenging it. To test the validity of the Okun's assumption, this study formulates a-two variable (unemployment and economic growth rates) structural VAR procedure and then investigates it with annual Nigeria data for the 34-year period (1980-2014). This is because McCombie, Pugno and Soro (2002) argue **t**hat the relationship between productivity growth and unemployment is structurally contemporaneous and Christopher Sims advocates the use of VAR models to capture the evolution and the

interdependencies among multiple time series. Since we are not aware of any study purporting to address or that has explored this issue for the Nigerian economy using the same time period (1980 to 2014) the research thus fills a gap in knowledge and thus contributes to the literature. The remainder of the paper is organized as follows. Section 2 presents the stylized facts: growth-unemployment relationship in Nigeria. Section 3 describes the methodology. In Section 4 the empirical results are analyzed. Finally, Section 5 offers the conclusions.

2 Stylized Facts: Growth-Unemployment Relationship in Nigeria

Nigeria's economic growth has had a truncated trajectory. In the period 1960-70, the average Gross Domestic Product (GDP) recorded was 3.1 per cent growth rate (CBN, 2015). Around the oil boom era, (1970-78), average economic growth stood at 6.2 per cent - a remarkable growth for that matter. However, the average GDP growth from 1981 to 1983 stood at negative 2.7 accompanied by 6.4 per cent unemployment rate. After these periods, GDP growth persistent wore negative growth and that led to the introduction of structural adjustment programme (SAP) in 1986. Negative 10 and 5.3 per cent were recorded for GDP growth and unemployment rates respectively in 1986. It should be noted that the average performance of the economy after the introduction of SAP (1987 to 1989) was 8.9 per cent with that of unemployment rate at 5.6 per cent. From 1988 to 1998 the economic growth was in positive stance averaging 2.9 per cent while the unemployment figure stood at 3.5 per cent. Nigeria's unemployment rate galloped from ever 3.5 per cent low in 1999 to a high level 17.5 in 2000 the same period that paradoxically recorded 5 per cent economic growth. The unprecedented rise in the unemployment rate was largely attributed to the increased number of school graduates with no matching job opportunities, a freeze on employment in many public and private sector institutions as well as the slow disbursement of the capital budget by the Federal Government. The average unemployment figure for the period 2001 to 2008 was 13 per cent while that of growth was 10 per cent which signifies the continuity of the positive relationship between unemployment and economic growth. In the year 2009, unemployment figure stood at 25 per cent and the economic growth was averaged 5.5 per cent. A cursory look at the unemployment and economic growth shows that they maintained positive trend and stable rate since 2000 till 2014. This trend contradicts economic postulations that predict inverse relationship between the two phenomena. This development is worrisome and paradoxical as improvement in economic growth is naturally expected to be accompanied by a reduction in a number of persons able and willing to work, but have no job. This jobless growth phenomenon implies that most effort of the government to reduce unemployment for the past two decade has not yielded result.



Source: Authors'

3 Methodology

The theoretical foundation underpinning the reduced-form cyclical relationship between real output and unemployment was originally laid out by Okun (1962). Okun's specification was consistent with the production theory where the amount of labour employment was argued to depend on output growth (Prachowny, 1993). Okun originally suggested two alternative approaches for estimating the unemployment-outut growth nexus - first difference and gap models. While the first difference model has been favoured by Mankiw(1994, 2012), among others based on the argument that it represents convenient way to achieve stationarity in data containing a unit root, the gap approach is followed by Gordon (1984) and Hising (1991),Villaverde and Maza (2009). This study is based on the two approaches with the aim of providing a balanced treatment for the unemployment- growth relationship

3.1 The Difference Model

This method expresses the output (g_t) and unemployment (u_t) variables in first difference:

$$y_t - y_{t-1} = \psi_0 - \psi_1(u_t - u_{t-1}) + \varepsilon_{t,} \qquad t=1,..., T \qquad (1)$$

Where ε_t is a white noise disturbance term. The parameter ψ_0 is an intercept term capturing the mean growth rate, and ψ_1 is commonly known as the Okun coefficient measuring by how much changes in the unemployment rate produce changes in output. In order for this specification to be correct either the series between brackets have to be stationary or, if they were non-stationary, they have to be cointegrated to avoid spurious regressions.

3.2 The Gap Model

The second approach to estimating Okun's law is based on the notion that of the gap between actual and equilibrium output and the gap in the unemployment in the expression:

$$y_t - y_t^* = -\psi_1(u_t - u_t^*) + \varepsilon_t \qquad (2)$$

where y^* represents the potential output or trend level of output such as $y_t - y_t^* \equiv y_t^c$ capture the cyclical level of output (output gap); and u_t^* correspondingly represents the natural rate of unemployment and the other symbols have the same meaning as in Eq. (1). In this second specification, the left-hand side term represents the output gap, whereas $u_t - u_t^*$ captures the unemployment gap. In other words, the difference between the observed and potential real GDP captures the cyclical level of output.. Although several studies (Mankiw, 1994;2012;Akeju and Olanipekun, 2014), avoided the gap method based on the argument that there are no observable data on y^* and u^*. Meanwhile, Okun(1970) used linear trends to measure the potential output level and the natural rate of unemployment. Accordingly, this study focuses on estimation result that take possible stochastic trends into consideration. To surmount criticism of any individual detrending method in estimating the robustness of Okun's coefficients, this study applies different detrending techniques: the Hodrick–Prescott (HP) filter and the Baxter–King (BK) filter. They are discussed in turn.

The Hodrick-Prescott Filter is a smoothing method that is widely used among macroeconomists
to obtain a smooth estimate of the long-term trend component of a series. The method was first used in a working paper (circulated in the early 1980's and published in 1997) by Hodrick and Prescott to analyze postwar U.S. business cycles. Technically, the Hodrick-

Prescott (HP) filter is a two-sided linear filter that computes the smoothed series s of y by minimizing the variance of y around s, subject to a penalty that constrains the second difference of s. The optimizing problem is based on the expression:

$$\sum_{t=1}^{T}\left(y_t - s_t\right)^2 + \lambda\sum_{t=2}^{T-1}\left(\left(s_{t+1} - s_t\right) - \left(s_t - s_{t-1}\right)\right)^2$$

3

The penalty parameter λ controls the smoothness of the series σ. The larger the λ, the smoother the σ. As $\lambda = \infty$, s approaches a linear trend (Lee, 2000). The cyclical component can be written thus:

$$y_t^c \equiv y_t - y_t^*$$

4

Intuitively, the solution to equation 3 above provides a mapping from y_t to $s_{t\ with}$ the relevant gap data series y_t^c determined residually based on equation 4.

The HP filter is a widely used method for discerning business cycle dynamics. For instance, Giorno et al. (1995) apply this filter to extract trend and cyclical components from output data. King, Stock and Watson (1995) use HP filter to explore the Philips curve relationship over the business cycle frequency. The second approach the study would use to decompose an I(1) series into a stochastic trend and cyclical component is the band-pass (frequency) filters suggested by Baxter-King (1999) (BK), and the second by Christiano-Fitzgerald (2003) (CF). This method employs a fixed lead/lag length.

3.3 Data Source

While the data of unemployment used for this study were obtained from Annual Abstract of Statistics (2014) and various issues of the National Bureau of Statistics, that of the Real GDP were derived from the Central Bank of Nigeria's Statistical Bulletin (2014). Annual data understudy is from the period 1980 to 2014 for Nigeria.

4 Analysis of Results

4.1 Unit Root Test

The results of the unit root test are presented in Table 1 below. Comparing the Augmented Dickey-Fuller test statistic(-4.72) with its critical values (-3.65) and (-2.95) for the growth variable, the results confirm that the growth variable is stationary at first difference i.e integrated of order one I(1). Based on unemployment result, the same order of integration holds. The null hypothesis of non-stationarity can therefore be rejected, that all variables employed have potential structural relationship (GDP growth, Unemployment). Based on this confirmation (that the variables do have unit root problem), we hereby conclude that all variables are integrated of order 1, the results which further certify the conduct of further test.

Table 4.1: Unit Root Test of GDP and Unemployment Data using ADF Statistic

Stationarity test for variables					
Variables		**ADF test stat**	**Critical values**		**Order of integration**
			1%	**5%**	
GDPG	Level	-4.715920	-3.646342	-2.954021	I(1)
	1st diff	-8.569793	3.653730	-2.957110	
UNEM	Level	0.263623	-3.646342	-2.954021	I(1)
	1st diff	-7.069919	-4.211868	-3.529758	

Source: Computed by the authors. Note: Tests include both intercept and trend

Table 3 shows the result from the lag structure test. AR Roots Table/Graph investigates the lag structure of our model and reports the inverse roots of the characteristic AR polynomial (Lütkepohl, 1991). The estimated inverse root indicate that the (VAR) equation is stable (stationary) since all roots except 1 have modulus less than 1 in table 3 and lie inside the unit circle in figure 1. This is in line with the unit root result that shows first order of integration that confirms the stability of the series employed. Assuming the VAR equation is not stable, the impulse response standard errors result would be invalid and the variance decomposition is inefficient.

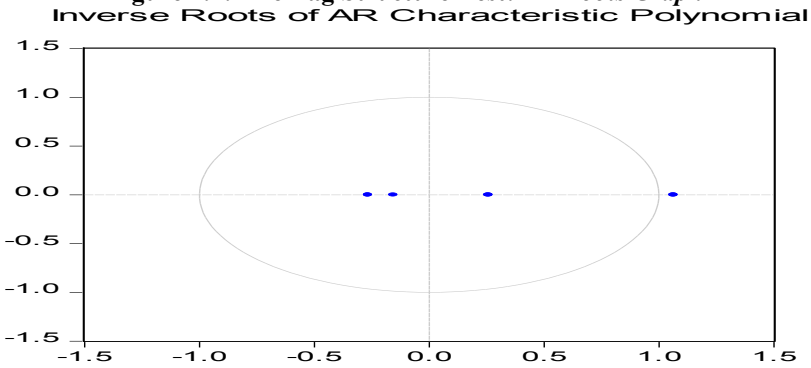
Table 4.2: The Lag Structure Test: *AR Roots Table*

Roots of Characteristic Polynomial
Endogenous variables: GDPG UNEM
Exogenous variables: C
Lag specification: 1 2
Date: 07/11/16 Time: 14:39

Root	Modulus
1.064834	1.064834
-0.264400	0.264400
0.259046	0.259046
-0.153998	0.153998

Warning: At least one root outside the unit circle.
VAR does not satisfy the stability condition.

Figure 4.2: The Lag Structure Test: *AR Roots Graph*



In determining whether the time series variables employed in this study are useful in forecasting one another, we employed Granger causality technique. The results of the Granger causality test are shown in the table 4 below (confidence interval is 95%). From these results, we can see that when the cause variable is unemployment rate, the p value of the test is 0.3317. It is more than 0.05, we do not reject the null hypothesis. That is unemployment does not Granger cause GDP growth. Also, when the cause variable is GDP growth, the p value of the test is 0.7908. It is more than 0.05, we do not also reject the null hypothesis. That is, GDP growth does not Granger causes unemployment rate.

Table 4.4: VAR Granger Causality/Block Exogeneity Wald Tests

Cause Variable	Chi-sq	p-value	Null hypothesis	Decision
GDP growth	2.2068	0.3317	Unemployment rate do not Granger cause GDP growth	Do not reject the null hypothesis
Unemployment	0.4695	0.7908	GDP growth do not Granger cause Unemployment rate	Do not reject the null hypothesis

Source: Authors

Table 4.5: Pairwise Granger Causality Tests

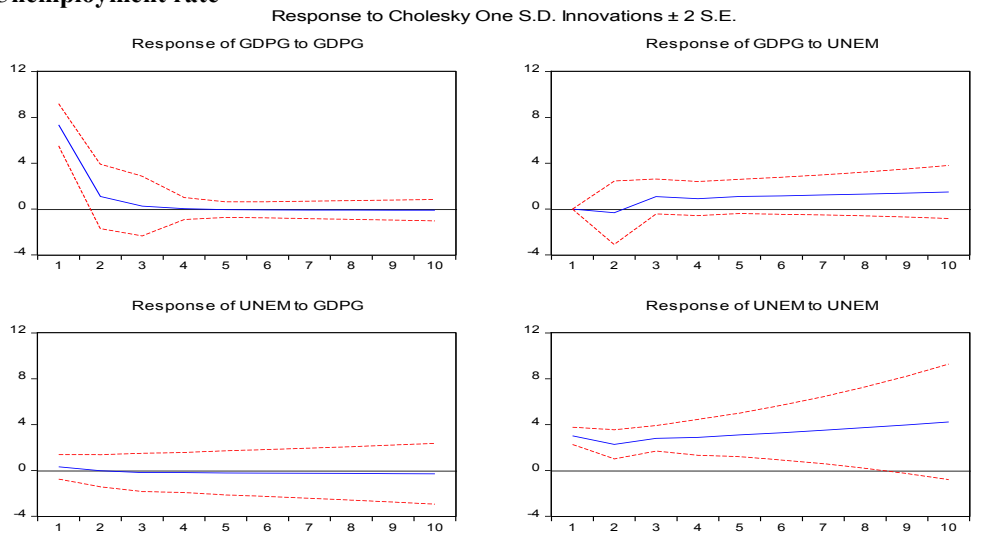
Null Hypothesis:	Obs	F-Statistic	Prob.
UNEM does not Granger Cause GDPG	**32**	**1.10342**	**0.3462**
GDPG does not Granger Cause UNEM		**0.23477**	**0.7924**

Source: Computed by the authors

The simultaneous causality among the variables employed imply that they are individually and collectively not a good predictor of one another.

The results obtained from the impulse response are shown in figures 2 – 4. Figure 2 displays the impulse response of agricultural growth to a shock in itself, to GDP, manufacturing growth and service growth.

Figure 4.3: The Impulse Response of GDP Growth to a Shock in itself and Unemployment rate



The result indicate that the response of GDP growth to itself persists negatively till third period after which it moderates, plateaus and their effects eventually die out. This implies that shocks to the GDP growth creates an initial negative till the third period and thereafter falls to zero. When the shock is from growth, the response to unemployment has a mild initial fluctuation from period one to two, thereafter experiences positive and smooth fluctuation.

A more interesting result is how unemployment responds positively to shocks in itself. This result based on the above graph shows that unemployment may continue to generate more unemployment.

The shock from unemployment to of GDP growth shows almost zero response from first period till the last period. This result supports the minimal relationship between the two variables under study. This is a confirmation of the assertion by some analysts that economic growth in Nigeria is not tricking down**.** This substantiates the earlier granger causality result that shows zero relationship between the two variables understudy.

Table 4.6: Estimates of Okun's Law: Robust OLS

	Gap (Model 1)	Difference (Model 2)
C	-0.9942	-0.25132
UNE	-0.01772 (0.1912)	0.2294 (0.3365)
Observation	451	451
Rw-squared	66%	77%
Adjusted Rw-squared	66%	77%
Akaike info criterion	71.94%	66.22%
Prob(Rn-Squared stat)	0.0000	0.0000

*Notes: * denote 5 percent levels of significance, respectively. Probabilities are in parentheses.*

Table 4.6 is the result based on robust ordinary least square method. Although the gap model meets the a priori expectations based on the negative relationship between unemployment and growth it is clear that none of the results is significance based on 1%, 5% and 10% levels of significance. The result from the difference model does not meet the a priori expectation nor the significance level of 1%, 5% and 10%. This means Nigeria is experiencing growth without an expansion of jobs, challenging investors, employers and industries to adapt to the new economic order. The reason for this unexpected outcome might not be unconnected with the persistent increase population growth, large number of graduates that higher education turns out everyyear coupled with the global financial crisis rocking Nigeria. The result is in line with the view of Lal *et al.* (2010), Arewa and Nwakanma (2012), Bankole and Fatai (2013) and Vakulenko and Gurvich (2015). Arewa and Nwakanma (2012), Bankole and Fatai (2013) for instance opined that, the kind of economic growth Nigeria celebrates does not translate to solving the unemployment problem. The result from this study is however not in tandem with the work of Bajo-Rubio, Díaz-Roldán, & Esteve (2007); Maza and Villaverde, (2007); Mankiw (2012) and Romer (2012); Marth(2015); Dixon, Lim and Ours (2016) that argue that Okun' s law could be considered a near-rationale rule of thumb to be used by all economies.

5 Conclusion

This paper has estimated Okun's coefficients for the Nigerian economy as it is an interesting case study due to her noticeable unemployment-growth rates convergence using annual time series data for the period 1981-2014. The study tested and confirmed that the data employed were unit root free using Augmented Dickey-Fuller (ADF). The tests reject the null hypothesis of non-stationarity for all variables employed since they certified order 1. The same order of integration for each of the variables was a necessary condition to compute further empirical analysis, i.e. to test the equilibrium relationship. The study made use of the two alternative models for robustness - a first difference and a gap model. The estimated inverse root results indicate that the (VAR) equation is stable (stationary) since all roots except one have modulus less than one and lie inside the unit circle. However, the results

obtained from VAR Granger Causality/Block Exogeneity Wald Tests show that individually and collectively there is no granger causality between GDP growth and unemployment rate. The results from impulse response of economic growth to unemployment display lack of linkage between the two macroeconomic variables in Nigeria. The result implies economic growth does not explain the unemployment problem in Nigeria. The results from robust OLS suggest Positive relationship without any level of significance which implies economic growth does not explain the unemployment problem in Nigeria. Based on these findings the study therefore concludes that the increasing economic growth associated with rising joblessness suggest that Okun's law is not valid in Nigeria. This means the acclaimed economic expansion usually announced for the past two decades has not been associated with productivity and job creation. This study therefore recommends government should vigorously pursue and implement policies devoted to boost productivity and job creation.

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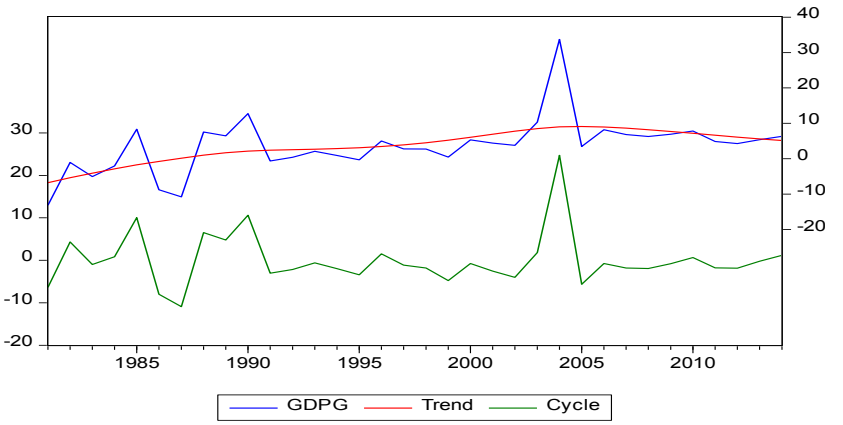
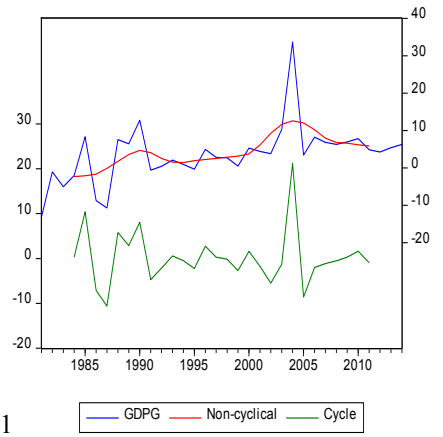
Appendices: Appendix 1

Fig 2: Hodrick-Prescott Filter (lambda=100)

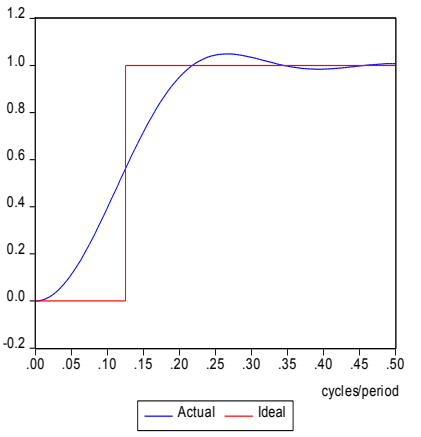


Irregular trend gdp 1980 to

Fixed Length Symmetric (Baxter-King) Filter



FrequencyResponse Function



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Appendix 2

Dependent Variable: GDPG
Method: Robust Least Squares
Date: 07/11/16 Time: 15:10
Sample: 1981 2014
Included observations: 34
Method: M-estimation
M settings: weight=Bisquare, tuning=4.685, scale=MAD (median centered)
Huber Type I Standard Errors & Covariance

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.994216	1.114879	-0.891771	0.3725
UNEM	0.106337	0.257971	0.412204	0.6802
HPTREND04	0.751464	0.170763	4.400618	0.0000
HPTREND05	-0.017727	0.289777	-0.061174	0.9512

Robust Statistics

R-squared	0.229388	Adjusted R-squared	0.152327
Rw-squared	0.660462	Adjust Rw-squared	0.660462
Akaike info criterion	71.93964	Schwarz criterion	79.45997
Deviance	375.2767	Scale	2.396282
Rn-squared statistic	34.82799	Prob(Rn-squared stat.)	0.000000

Non-robust Statistics

Mean dependent var	3.701089	S.D. dependent var	7.785015
S.E. of regression	6.693447	Sum squared resid	1344.067

Dependent Variable: DGDPG
Method: Robust Least Squares
Date: 07/20/16 Time: 14:50
Sample (adjusted): 1981 2014
Included observations: 34 after adjustments
Method: M-estimation
M settings: weight=Bisquare, tuning=4.685, scale=MAD (median centered)
Huber Type I Standard Errors & Covariance

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.251321	1.086038	-0.231411	0.8170
UNE	-0.179255	0.090869	-1.972684	0.0485
GDPG	0.708171	0.091352	7.752145	0.0000
DUNE	0.229422	0.238711	0.961088	0.3365

Robust Statistics

R-squared	0.197493	Adjusted R-squared	0.117242
Rw-squared	0.773065	Adjust Rw-squared	0.773065
Akaike info criterion	66.21857	Schwarz criterion	74.06855
Deviance	465.5281	Scale	2.786319
Rn-squared statistic	61.65952	Prob(Rn-squared stat.)	0.000000

Non-robust Statistics

Mean dependent var	0.540905	S.D. dependent var	9.101240
S.E. of regression	7.626383	Sum squared resid	1744.852