Okun's Law - an empirical test using Brazilian data

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ABSTRACT

In this paper, we test Okun's coefficient to determine if the relationship between GDP and the employment rate holds true for the Brazilian economy during our testing period. Using quarterly data ranging from 1997Q1 to 2015Q2, we develop a finite distributed lag model so that we can examine the relationship between the change in the unemployment rate as the dependent variable and the growth rate in GDP as the independent variable. Our findings indicate that the Okun's coefficient is significant at 1 lag of GDP in our model. Our estimate of Okun's coefficient is -0.140473.

Keywords: Brazil, Okun's law, GDP, Unemployment, Growth

INTRODUCTION

In 1962 Arthur Okun stated that there should be a significant negative relationship between a country's unemployment and its GDP growth rate. This became known as Okun's law. More specifically, the "law" suggests that there should be a negative relationship between the change in the unemployment rate and the growth rate in GDP. In numerical terms, the law suggests that a 1 percent decline in unemployment rate may lead to an increase in GDP by 2 percentage points. There have many quite a few studies in recent years that test the validity of the proposed relationship between changes in unemployment rate and GDP growth rate. The results, however, have been inconclusive. In this paper, we will test the "law" by using Brazilian data.

The Brazilian economy is the eighth largest economy in the world and the largest in South America. Brazil had made improvements in its economy up until the global recession of 2008, which saw the economy contract for two consecutive quarters. After a brief rebound in economic activity following the 2008 global recession, Brazil has recently seen its unemployment rate begin to increase and GDP decline.

In this paper, we test Okun;s law to see if it holds for Brazil during our testing period. Many studies have tested Okun;s law but the results have been inconclusive. Okun's law was developed by Arthur Okun (1962) who estimated coefficient by examining the relationship between the unemployment rate and the changes in output growth. He found empirically that a 1 percent decline in unemployment rate lead to an increase in output growth by 2 percent.

The purpose of this paper is to test Okun's law using Brazilian data from 1997 to 2015 to see if Okun's law pertains to the Brazilian economy. Our results indicated that at both current and at 1 lag of GDP, Okuns coefficient holds for Brazil and was significant at the 95% level of confidence.

The rest of the paper is organized as follows. Section II provides a brief review of the literature. Section III discusses the methodology while section IV describes the data used in the study. Section V discusses the results which is followed by the conclusion in section VI.

LITERATURE REVIEW

Okun's law, developed by Arthur Okun is an important concept in macroeconomics and has been studied extensively in the literature. However, the literature pertaining to Okun's Law has provided mixed empirical results and findings depending on the testing periods, comparisons of different countries and methodologies used.   For example, Knotek (2007) found that the U.S. economy grew at an annual rate of 3.4% from 2003 to 2006 and unemployment dropped during this period. However, in the following year, growth slowed but the unemployment rate continued to fall. Knotek (2007) sought a further explanation and to answer the question is Okun's Law still useful? Tombolo and Hasegawa (2014) examined the Brazilian economy from 1980Q1 until 2014Q3 and found the relationship between growth and unemployment ranged between -0.1878 and -0.2055 based on the different models used their study. Their findings empirically suggested that Okun's law is still useful. Irpan, Saad, and Ibrahim (2016) studied the relationship between unemployment rate and GDP growth from 1982 to 2012 in Malaysia.   They found Okun's coefficient to be 3.5 percent, well beyond the empirical findings found by Arthur Okun (1963) in his original study. Why does Okun's coefficient differ between countries? To answer this question, we examined, Moosa (1997) study which examined Okun's Law in G7 countries. After removing cyclical unemployment and output using Harvey's time series model, Moosa (1997) found that differences in Okun's coefficient were explained by labor market rigidities. In a more

recent study, Bankole and Fatai (2013) estimated Okun's coefficient for Nigeria from 1980 to 2008. Using both Engle and Granger (1987) cointegration test and a fully modified OLS models, they found that Okun's law did not hold for Nigeria during the testing period. The implications from their findings indicated that policy makers focus on structural changes and labor market reforms. Based on a brief review of the literature, the mixed results found in the literature indicates that Okun's coefficient needs further exploration.

METHODOLOGY

In testing Okun's Law for the Brazilian economy a finite distributed lag model is developed. We estimate the following model by examining 1 lag of the independent variable (Gross Domestic Product) and no lag of the dependent variable (Unemployment Rate). We use 1 lag of the independent variable because the AIC criterion is minimized. By minimizing the AIC criterion, we can select the best model that produces the highest coefficient of determination, R^2. This study is similar to Tombolo and Hasegawa (2014) in that they estimated the Okun coefficient for the Brazilian economy. However, this study differs in many respects such as the models used to estimate Okun's coefficient, the testing period, and the sources of the data. Tombo and Hasegawa (2014) used models developed by Sogner and Stiassny (2002) and Gordon (1984) to estimate Okun's coefficient in their study.

DATA

The data used in this study consisted of the Brazilian unemployment rate and the Brazilian GDP. The data are retrieved from the FRED database of the St. Louis Federal Reserve Bank and consists of seasonally adjusted quarterly data that spanned from 1997Q1 to 2015Q2. The unemployment rate is computed as the change in unemployment, while, GDP is defined as the growth rate in output for one lag. I use the following model to estimate Okun's Law for the Brazilian economy:
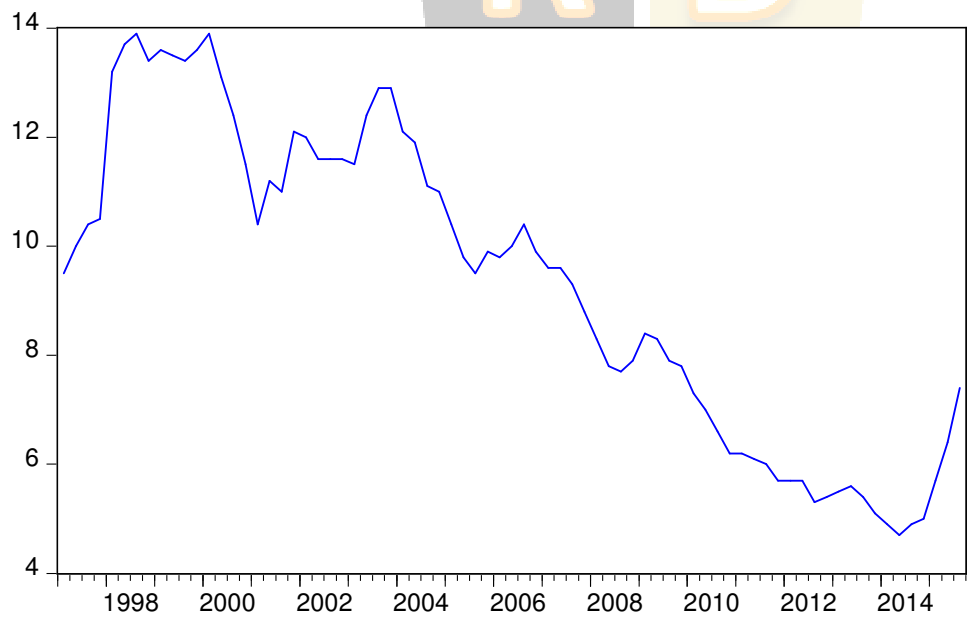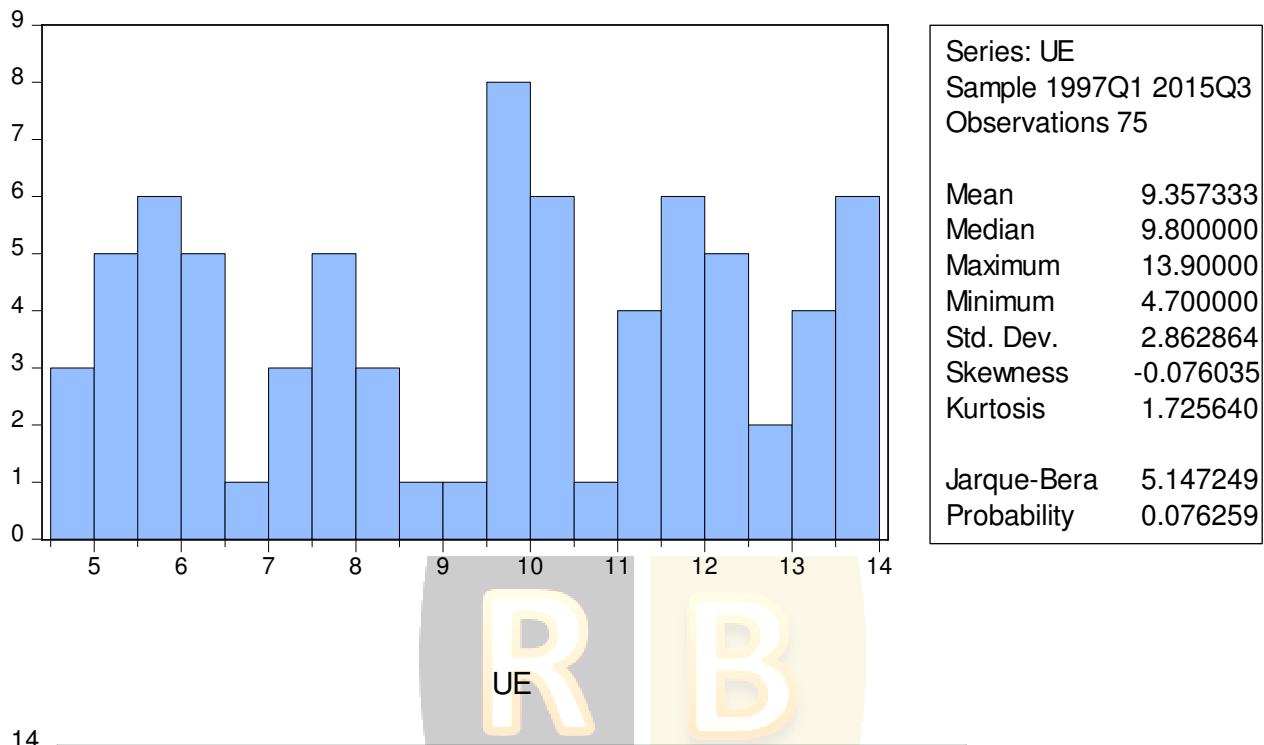
$$DU_t = \alpha + \sum_{s=0}^{q} B_s \ G_{t-s} + e_t$$

Where DU represents the change in the unemployment rate, and G_{t-s} represents the lag change in gross domestic product; e_t represents the error term.

RESULTS

The summary of statistics in table 1 display the unemployment rate for Brazil from 1997Q1 to 1015Q2. The average unemployment rate during the testing period is 9.35%. The unemployment rate had a median of 9.90 with a minimum and maximum range between 4.70 and 13.90. The Brazilian economy has battled high unemployment during out sampling period. This is an issue policy makers must address in terms of both the social cost and economic costs. Figure 1 also displays that Brazil has battled with high employment for years. Unemployment peaked in 2000, reached its lowest levels in early 2014 but also began to rise again in 2014.

Table 1: Statistics for Unemployment Rate

Series: UE	
Sample 1997Q1 2015Q3	
Observations 75	
Mean	9.357333
Median	9.800000
Maximum	13.90000
Minimum	4.700000
Std. Dev.	2.862864
Skewness	-0.076035
Kurtosis	1.725640
Jarque-Bera	5.147249
Probability	0.076259

Figure 1: Brazil unemployment rate

Table 2 displays the growth rate for GDP during our testing period. The average growth rate in GDP was .64 during the sampling period. The median growth rate in GDP was .97. The GDP growth rate displayed a minimum and maximum range between -3.84 and 2.51. Figure 2 indicates that the growth rate in GDP has been somewhat volatile during the sampling period. Noticeably 2008 saw the growth rate in GDP to nearly -4%. This time frame also shows that the financial crisis of 2008 contracted the growth rate in output for the Brazilian economy severely.

Table 2: Brazil GDP growth rate
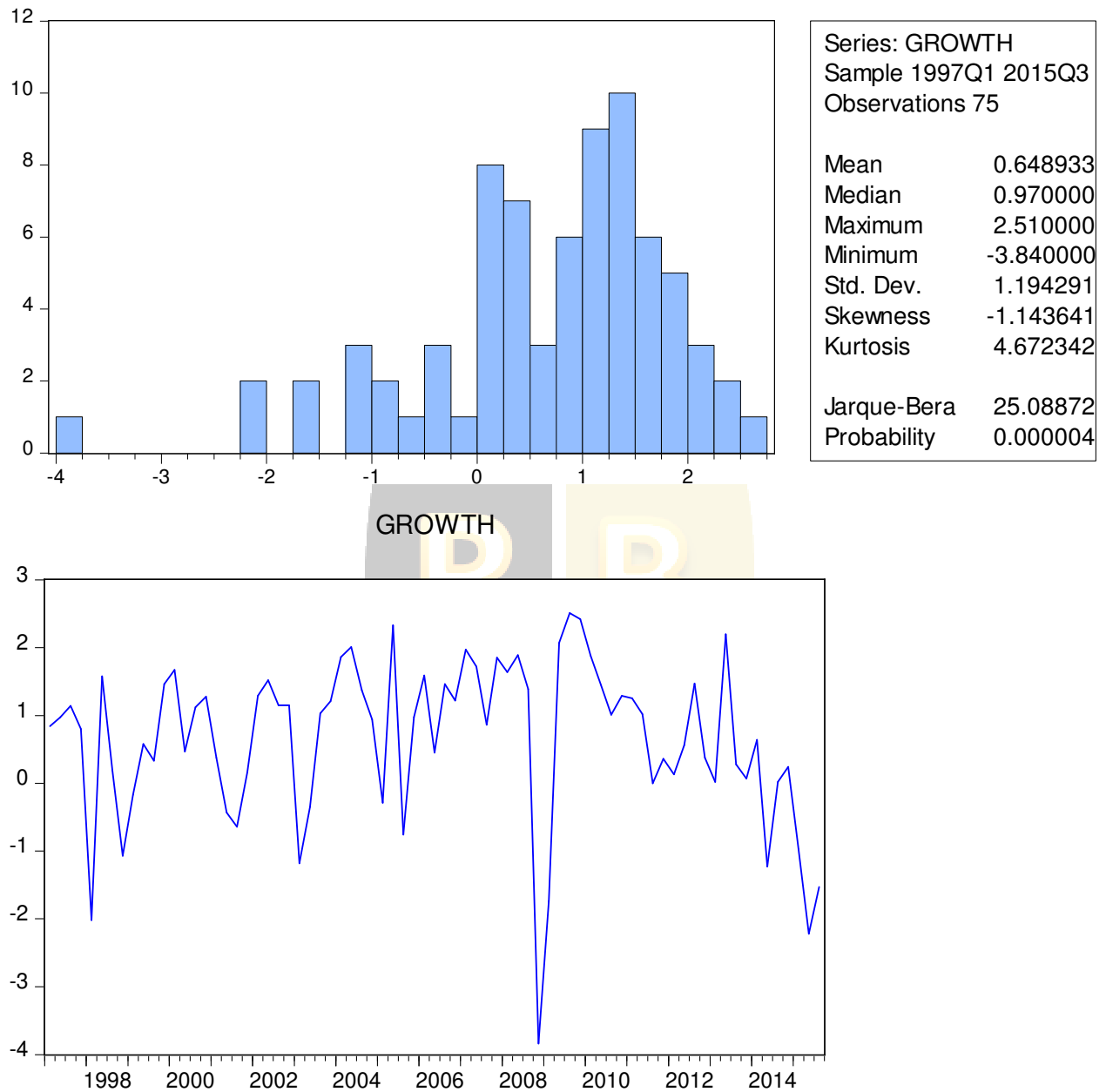
Figure 2: GDP growth rate

Table 3 displays the least squares estimates of the relationship between the growth rate and the unemployment for the Brazilian economy during the sampling period based on one lag. The coefficient of Growth and its lag display the appropriate negative sign and are significantly different from zero at the 5% level of significance. It is estimated that a 1% increase in the growth rate causes unemployment to fall by .15% in the current quarter and fall by .14% in the next quarter, holding all factors constant. The one period multiplier is given by $b_0 + b_1 = -0.296173$. The natural growth rate is ${\alpha}/{(b_0 + b_1)} = .565$ during the sampling period. The

implications from our study is that during the testing period, Okun's law does hold.

Table 3: Lag length = 1

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.167469	0.066884	2.503884	0.0146
GROWTH	-0.155570	0.049055	-3.171339	0.0022
GROWTH(-1)	-0.140473	0.050204	-2.798031	0.0066
R-squared	0.275321	Mean dependent var		-0.028378
Adjusted R-squared	0.254908	S.D. dependent var		0.549351
S.E. of regression	0.474193	Akaike info criterion		1.385290
Sum squared resid	15.96497	Schwarz criterion		1.478698
Log likelihood	-48.25573	Hannan-Quinn criter.		1.422552
F-statistic	13.48722	Durbin-Watson stat		1.679311
Prob(F-statistic)	0.000011			

CONCLUSION

Arthur Okun or Okun's law has received great attention in the literature, but the results have been inconclusive. Some studies find that Okun's law does not show a relationship between unemployment and growth, while other studies find the opposite result. In this study, we develop a finite distributed model with one lag of the growth rate. The results from our study show that Okun's coefficient does display a significant relationship between the unemployment rate and the growth rate for Brazil during our testing period.

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