The Relationship Between Unemployment and Output in Algeria (1989-2016)

العلاقة بين البطالة والناتج في الجزائر (1989-2016)

KORI YAHIA Abdellah, lecturer, Boumerdes University, Algeria**.**

Received: 06/04/2018; **Revised**: 31/05/2018; **Accepted**: 28/10/2018

Abstract:

The objective of this paper is to investigate the relationship between economic growth and change of unemployment rates (Okun's Law) in Algeria for the 1989- 2016 period. The difference and the dynamic version of Okun's law and the Autoregressive Distributed Lag (ARDL) linear model are employed to estimate the Okun coefficient. The results indicate a low negative Okun coefficient of about -0.78 % which explains the still high level of unemployment in Algeria, despite investment programmes implemented by the government to support economic growth.

Keywords: Dynamic Linear Models, Unemployment, Okun Coefficient.

Jel Classification Codes : E2, E24.

مستخلص:

الهدف من هذه الدراسة هو اختبار العلاقة بين معدل النمو الاقتصادي ومعدل البطالة (قانون اوكن) في الاقتصاد الجزائري خلال الفترة 1989-2016. ولتقدير معامل اوكن تم استعمال صيغة الفروق والصيغة الديناميكية لقانون اوكن، ونموذج الانحدار لفترات الإبطاء الموزعة ARDL. نتائج الدراسة أظهرت أن مقدر معامل أوكن في الجزائر هو في حدود -0.78% وهو ما يفسر بقاء معدلات البطالة مرتفعة في الجزائر بالرغم من البرامج الاستثمارية الضخمة التي نفذتها الحكومة من أجل دعم النمو الاقتصادي.

الكلمات المفتاحية: النماذج الخطية الديناميكية، البطالة، معامل أوكن.

تصنيف JEL: E2, E24.

* **Correspondent author's**: KORI YAHIA Abdellah; koriiab@live.fr.

1. Introduction

The Okun's law investigates the empirical relationship between the unemployment rate and growth rate of Gross Domestic Product (GDP) in a country (or ensemble of countries).

It is very important to estimate the relationship between unemployment and growth rate in an economy, because it suggests room for policymakers to improve aggregate output and reducing unemployment. This relationship is helping to explain the changes in unemployment when GDP growth is known, also predict changes in unemployment given predictions of GDP growth [Lancaster D., Tulip P., (2015)]. This approach builds on a simple theoretical view: "increased production in an economy leads to decreases in unemployment" [Zanin L., Marra G, (2012)].

This paper uses The Autoregressive Distributive Lag (ARDL) approach to determine both the short run and long run effects of GDP growth on unemployment in Algeria (Okun coefficient) using annual data from 1989 to 2016.

The relationship between unemployment and economic growth has been extensively studied since Okun's study in 1962 (cited in Farsio & Quade, 2003), which determined that when unemployment is reduced by 1 percentage point, GNP (Gross national product) increases by approximately 3%. In Algeria, Adouka and Bouguell (2010) using Error Correction Model (ECM) with annual data during the period 1970-2010, find a negative relationship between unemployment and output in the long term, an increase in real GDP of 1% decrease the unemployment rate by 0.2% in the long term [Adouka L., Bouguell Z., (2010)].

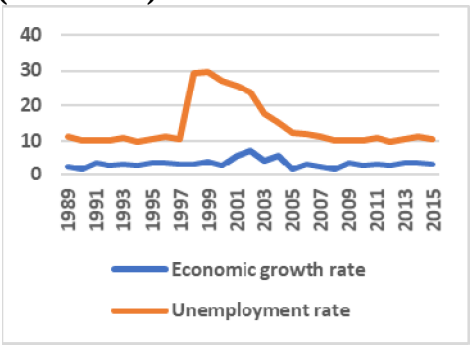
The remainder of this paper is organized as follows: Section 2 and 3 offers a descriptive analysis of unemployment in Algeria and theoretical framework of Okun's law respectively. Section 4 and 5 provides a literature review and the methodologies used. Section 6: reports the empirical results. The last section presents a conclusion.

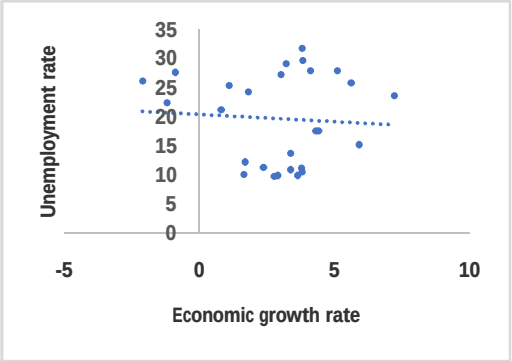
2. Unemployment in Algeria

Algeria is highly dependent on its hydrocarbons sector. This has become a cornerstone of the economy, being a source of foreign currency, and arguably the most crucial factor in raising per capita income. Oil constitutes approximately 98% of the country's total exports, provides approximately 70% of government revenues and constitutes some 40% of GDP.

Figure 1 shows the evolution of unemployment rate and growth rate in Algeria during the period 1989- 2016:

Figure 1: Relationship between output and unemployment in Algeria (1989-2016)





- Economic growth has probably contributed to the fall in unemployment, real GDP growth increased from 3% in 2001 to 7.2% in 2003 and 5.9% in 2005, followed by a sharp slowdown in 2006 and 2007 to around 1.7% and 1.6% respectively, partly because the surge in international oil prices.
- The Algerian government has pursued an expansionary fiscal policy, through the implementation of a series of substantial public investment programs. For example, between 2001 and 2012, the government implemented four public investment programs, worth around US$462 billion (Chibi et al., 2014). The ratio of government spending to GDP increased from 30% in 1989 to 47% in 2015, this large public investment in all sectors of the economy has contributed to a reduction in unemployment during this period, which decreased from 30% in 2000 to 10.5% in 2016. This public employment programs created about 6.25 million jobs between 1999 and 2008. [Furceri D., (2012)]. However, compared to the volume of investment during this same period, the contribution of public investment to economic growth seems lower than expectations for the country. The Algerian public sector has invested an average annual rate of 10% of GDP to receive less than 4.5 percent as an average annual rate of growth between 2001 and 2016. This poor contribution of public expenditure in economic growth confirms that not all the investments undertaken in Algeria in this period were productive which could be explained by the absence of a strong productive industrial sector, and the weak effectiveness of the public sector (Chibi et al., 2014). The rates of growth of different sectors of the domestic economy support this point; between the periods 1990–99 and 2000–16 the shares in GDP of the industrial sector, construction and public works sector

and services sector decreased from 12% to 7%, from 13% to 12% and from 29% to 27% respectively. Conversely, the share of the Hydrocarbons sector increased from 33% to 44%.

- The unemployment rate in Algeria (10.5% in 2016) remains high compared to other Middle East and North Africa (MENA) countries and in Eastern European transition countries. For instance, in 2014, the unemployment in Iran is 10.6%, Morocco 10.2%, Turkey 9.2%, MENA countries 8.8%, Venezuela 7%, Indonesia 6.2%, Saudi Arabia 5.6%, Russia 5.1%, China 4.7%, Nigeria 4.8%).

3. Okun´s law:

Economic theory suggests that increased production in an economy leads to decreases in unemployment [Zanin L., Marra G, (2012)]. This inverse relationship is known Okun's law. Okun described how percentage changes in the real growth rate affected the change in the unemployment rate in percentage points at a pre-defined period. [Lancaster D., Tulip P., (2015)].

In his paper, Okun (1962) used quarter data from 1948 to 1960 to explain the relationship between the unemployment rate (as the dependent variable) and the change in output (as independent variable) in USA. Since it, a several scientific contributions have investigated Okun's law. (e.g., Viren 2001; Cuaresma 2003; Holmes and Silverstone 2006; Perman and Tavera, 2007; Zanin and Marra, 2012).

As noted in the literature review, previous authors have used various versions of Okun's Law in conducting their studies (Dare, (2016)):

The difference version:

$$U_t - U_{t-1} = \alpha + \beta * (Y_t - Y_{t-1}) + \varepsilon_t$$

where U_t is the actual unemployment rate at time *t*, U_{t-1} is the actual unemployment rate at time *t-1*, Y_t is the real output growth at time *t*, Y_{t-1} is the real output growth at time *t-1*, and ε_t is the error term at time *t*.

This equation shows how the output growth and unemployment rates change simultaneously, where β is Okun's coefficient with a negative value. This means that an increase in output should lead to a decrease in the unemployment rate.

The gap version :

$$U_t - U_t^* = \alpha + \beta * (Y_t - Y_t^*) + \varepsilon_t$$

where U_t^* is the natural rate of unemployment, Y_t^* is the potential output at time *t*. In this version, Okun focused on the gap between actual and potential output where full employment is achieved. According to Okun, a high

unemployment rate will be associated with idle resources, whereby actual output is expected to be below its potential and vice versa. Okun's gap version was based on the assumption that full employment occurs when the unemployment rate is 4%. Given this assumption, Okun constructed a series of potential output levels for the United States. However, by changing the full unemployment rate, different potential output levels can be measured.

The Dynamic version :

$$D(U_t) = \alpha + A_0 D(GDP_t) + A_1 D(GDP_{t-1}) + A_2 D(GDP_{t-2}) + B_1 D(U_{t-1}) + B_2 D(U_{t-2}) + \varepsilon_t$$

where $D(U_t)$ is the first difference of current unemployment rate, $D(GDP_t)$ is the first difference of current real GDP, $D(U_{t-1})$ is the first lag of unemployment rate, $D(U_{t-2})$ is the second lag of unemployment rate, $D(GDP_{t-1})$ is the first lag of the first difference of current real GDP, $D(GDP_{t-2})$ is the second lag of the first difference of current real GDP.

According to Okun's observations, current unemployment can be affected by current and past output as well as past unemployment as shown in the dynamic version.

4. Literature Review:

After the publication of Okun's seminal paper, many studies were carried out to test Okun's law in several countries. Table 1 provides estimates of the Okun coefficient in some developed and developing countries - including Algeria for various version of Okun's Law.

Table 1: Estimates of the Okun coefficient in some developed and developing countries.

Source	**Country**	**Okun Coefficient**
Okun A .M (1962)	United state	3
Oluyomi O., (2016)	Nigeria	1.75
Ezzahid E., El Alaoui A. (2014)	Morocco	-0.14
El Andari. Chifaâ, Bouaziz. Rached (2015).	Tunisia	1.4
Central Bank OF Malta, (2013)	Malta	-0.15
Alamro H, Al-dala'ien Q. (2014)	Jordan	0
Elshamy H., (2013)	Egypt	-0.02
Adouka L., Bouguell Z. (2010)	Algeria	-0.2
Moussa I., (2008)	Egypt	-0.007
	Algeria	-0.045
	Morocco	-0.015
	Tunisia	0.032
Abdula R., Hilal Juda N. (2010)	Irak	-0.11

5. Methodology:

The Autoregressive Distributive Lag (ARDL) approach is proposed by Pesaran and Pesaran (1997) and Pesaran and Shin (1999), Pesaran and Shin (1999), Pesaran*et al*. (2001).

Similar to Alamro and Al-dalaien (2014), the ARDL (p, q) model for the dependent variable Y_t and the independents variables X_t is represented by the following equation:

$$D(Y_t) = c + \sum_{i=1}^{p} a_i D(Y_{t-i}) + \sum_{j=0}^{q} b_j D(X_{t-j}) + \lambda_1 U_{t-1} + \lambda_2 X_{t-1} + v_t$$

a_i, b_j are the parameters which is related to the short-run dynamics of the model, c : intercept, D: denotes the first difference, v is a $(T \times 1)$ vector of unobservable independent and identically distributed stochastic disturbances with a multivariate normal distribution, mean zero and covariance matrix $\sigma^2 I_n$, $\left(v_t \sim N\left(0, \sigma^2 I_T\right)\right)$. the ARDL model is estimated with the optimal lag length chosen according to the Akaike Information Criteria (AIC). λ_1 and λ_2 stand for the long-run relationship. A bounds test was conducted for the null hypothesis of no co-integration between the variables. The null-hypothesis of the model is:

$H_0 : \lambda_1 = \lambda_2 = 0$ (there is no long-run relationship/no co-integration)

$H_1 : \lambda_1 \neq \lambda_2 \neq 0$

The calculated Wald statistic was compared to the critical value tabulated by Pesaran (1997) and Pesaran et al. (2001). If the test statistic is above the upper critical value, the null hypothesis of no long-run relationship is rejected; if the test statistic is below the lower critical value, the null hypothesis is not rejected. However, if the test statistic is between the two critical bounds, the result is inconclusive.

IF the null hypothesis is accepted, the short run ARDL (p, q) model is represented by:

$$D(Y_t) = c + \sum_{i=1}^{p} a_i D(Y_{t-i}) + \sum_{j=0}^{q} b_j D(X_{t-j}) + v_t$$

According Pessaran and Pessaran (1997), the long-run elasticity can be estimated by:

$$\hat{\alpha} = \frac{\hat{c}}{1 - \sum_{i=1}^{p} \hat{a}_i}, \quad \hat{\beta} = \frac{\sum_{j=0}^{q} \hat{b}_j}{1 - \sum_{i=1}^{p} \hat{a}_i}, \quad (3)$$

The goodness of fit of the ARDL models was checked, and diagnostic and stability tests were conducted.

6. Empirical results:

This study uses annual macroeconomic data from the world bank for the period 1989-2015. The variables are: real GDP (RGDP); unemployment rate (U) and economic growth (Y) (measured by growth in the real GDP).

The difference version:

The equation of the difference version of Okun's law can be written as:

$$U_t - U_{t-1} = \alpha + \beta * Y_t + \varepsilon_t$$

Table 2 presents further econometric estimates for the difference version of Okun's Law for Algeria.

Table 2: Results of difference version estimations

Variables	Coefficients	T Statistics	P- value
C*	0.734350	0.96470	0.3439
Y*	-0.345208	0.213850	0.1190

* no Significant at 5 percent and 10 percent level of significant.

The value of Okun's negative coefficient is 0.34. This value explains that at every percentage point of real output growth over 2% is related with decrease in unemployment rate by 0.34 percentage point. Furthermore, with no increase in economic growth, unemployment will tend to increase by 7% from one year to another. Thus, an annual growth of around 2% is mandatory to keep unemployment unchanged.

The Dynamic version :

Before estimating the ARDL model, an Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests are used to check the stationarity for each variable. The unit root test could help in determining whether the ARDL model should be used Alamro H., Al-dala'ien Q., (2014).

The results of ADF and PP are reported in table 2 with 95% critical value. The null hypothesis of unit root cannot be rejected, which indicates that the series (U and GDP) have unit root, accordingly, the two variables are no stationary on level. Contrary, at first difference the null hypothesis is rejected and therefore U and GDP are stationary at the first difference.

Table 3: ADF and PP unit root tests

VAR	ADF		PP	
	Stats	**p-value***	**Stats**	**p-value***
U	-2.73	0.23	-2.68	0.25
D(U)	-3.89	0.02	-3.89	0.02
GDP	-2.79	0.21	-2.68	0.25
D(GDP)	-3.80	0.03	-3.84	0.03

ADF: Augmented Dickey-Fuller, PP: Phillips–Perron.

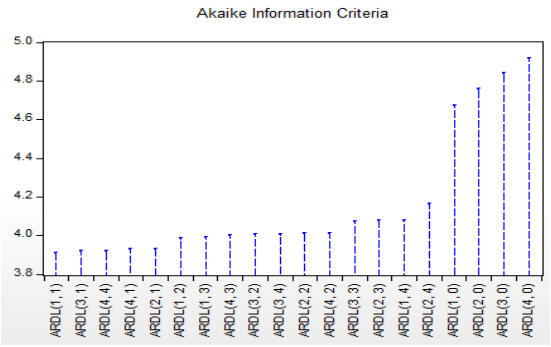
* p-values > 5% indicates that the test rejects the null hypothesis of stationarity at the 0.05 level .

Source: Authors' calculations

To check the existence of co-integration among the variables, the bounds test, which is a three-step procedure, was implemented:

The lag order was selected based on the Akaike's Information Criterion (AIC). As shown in Figure 2, the difference model is an ARDL (1,1) equation consisting of 1 lag for the dependent variable (unemployment) and 1 lags for the independent variable (output growth).

Figure 2: Estimate the true orders of ARDL model based on Akaike Information Criteria graphs



AIC: Akaike information criterion, Min AIC for (p=1, q=1).

The Wald test was conducted to check for the presence of a long-term relationship (Table 4). Given that the order of integration of all variables is I*(1)*, the null hypothesis of no cointegration cannot be rejected because the F-statistic is less than the upper critical bound at the 10%, 5% and 1% significance level.

Table 4: Results of bounds test

F-statistic*	K	90%		95%		99%	
		I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
0.571688	1	4.04	4.78	4.94	5.73	6.84	7.84

*F-statistics is less than the lower bound at the 5% significance level indicates that the null hypothesis of no cointegration cannot be rejected.
Source: Authors' calculations.

Table (5) shows the empirical results of the ARDL(1,1) estimation in the short run, a 1% increase in the real GDP growth rate leads to a 0.82% decrease in the unemployment rate.

Table 5: Results of ARDL(2,1) estimations (restricted model)

Variables	Coefficients	T	P- value
C*	1.619647	2.581959	0.017
DU(-1)	0.098594	0.686341	0.4997
Y	0.124676	0.719452	0.4794
Y(-1)*	-0.827001	-5.109814	0

* Significant at 5 percent level of significant. Adjusted R-squared=0.53
Source: Authors' calculations

The estimated values in the long run based on the relation (3) being:

$$\hat{\beta}=\frac{\sum_{j=0}^{q}\hat{B}_j}{1-\sum_{i=1}^{p}\hat{a}_i}=-0.779,\quad \hat{\alpha}=\frac{\hat{B}_0}{1-\sum_{i=1}^{p}\hat{a}_i}=1.796,\ \hat{\theta}=(1.796,\ -0.779)$$

The Okun coefficient $(\hat{\beta})$ is negative and significant which means that 1 percent increase in GDP growth will decrease unemployment rate by 0.78 percent.

To check the estimated ARDL model, some diagnostic tests are considered in table 6. The Table 6 shows that there is no evidence of autocorrelation at lag one and two, there is no evidence of heteroscedasticity, and the errors are normally distributed.

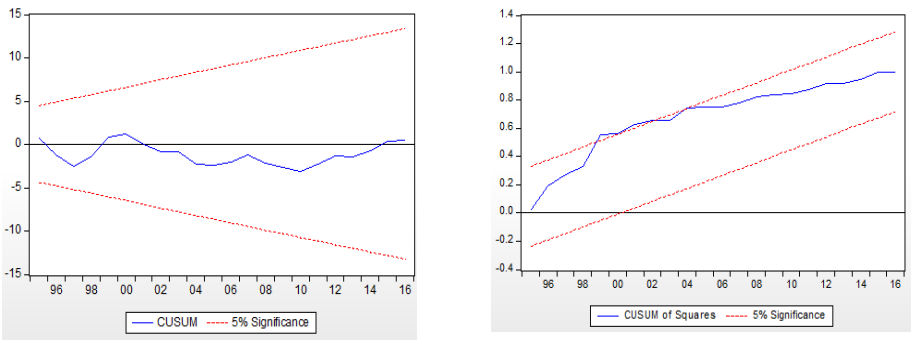
Table 6: Residual tests of ARDL(2,1) (restricted model)

Normality		Heteroscedasticity		Autocorrelation		
Jarque & Bera	p-value*	LM- Stat	p-value**	Lag	LM-Stat	p-value***
0.17	0.91	5.85	0.12	1	0.003	0.95
				2	0.01	0.99

*p-values > 5% indicates that the test rejects the null hypothesis of normality at the 0.05 level.

* * p-values > 5% indicates that the test rejects the null hypothesis of heteroscedasticity at the 0.05 level.
* ** p-values > 5% indicates that the test rejects the null hypothesis of autocorrelation at the 0.05 level.
The plot of the cumulative sum of the recursive residual is presented in figure 3. As shown, the plot of both the CUSUM test confirms the stability of the long-run coefficients of the GDP function in equations (1).

Figure 3: Cumulative Sum of Recursive Residuals



7. Conclusion and policy recommendations

The objective of this paper is to investigate the presence of Okun's (1962) relationship in Algeria for the 1989- 2015 period. An ARDL model is employed to determine both the short run and long run effects of GDP growth on unemployment in Algeria.
By combining the results of research, we can conclude that: 1) analyse of data during the period 1989-2015 shows a negative correlation between changes of unemployment and economic growth, 2) an estimation for the Okun coefficient in the long run of -078% which assumes that an increase of 1% of GDP in the long term would lead to a 0.78% decline in the unemployment rate in Algeria; 3) The estimated value of the Okun coefficient (-0.78%) is considerably more reduced, in an absolute sense, than the standard Okun coefficient of 3%; 4) these relative low output-employment elasticities are the main factors behind the still high level of unemployment; 5) this result also can be interpreted as an indication of a certain degree of rigidity of the labour market in Algeria, In particular; 5) an improvement in labour market conditions in Algeria could have a significant effect in reducing unemployment both in the short and long term.

References

Abdula R., Hilal Juda N. (2010), The Relationship Between Unemployment and Output in Egypt, Kadissia review, N/ 03.

Adouka L., Bouguell Z., (2010). Estimation de la loi de Okun en Algérie à l'aide de modèle ECM,RoaIktissadiaReview, Université Eloued, N 05.

Alamro H., Al-dala'ien Q., (2014). Modeling the relationship between GDP and unemployment for Okun's law specific to Jordan, Aqaba Special Economic Zone (ASEZA).

Arshad, Z., (2010). The validity of Okun's Law in the Swedish economy, Sweden: Stockholm University.

Central Bank OF Malta, (2013)., Estimating Okun's Law for Malta, https://www.centralbankmalta.org/file.aspx?f=631.

Chibi A., Benbouziane M., and Chekouri S., (2014). The impact of fiscal policy on economic activity over the business cycle: an empirical investigation in the case of Algeria. Working papers, No 845, The Economic Research Forum (ERF).

Cuaresma, J (2003), Revisiting Okun's Law: A Piecewise-Linear Approach. Oxford Bulletin of Economics and Statistics 65, 439-451.

Dare S. 2016,. The Validity of Okun's Law in Curaçao, Centrale Bank van Curaçao en Sint Maarten, working paper, 2016.

El Andari C., and Bouaziz R., (2015), Is the Okun's law valid in Tunisia?, https://mpra.ub.uni-muenchen.de/67998/3/MPRA_paper_67998.pdf.

Elshamy H., (2013),. The Relationship Between Unemployment and Output in Egypt, 1st World Congress of Administrative & Political Sciences (ADPOL-2012), Elsevier Ltd. Open access.

Ezzahid, E. and EL Alaoui, A. (2014), Economic Growth and Jobs Creation in Morocco: Overall and Sectors' Analysis. http://mpra.ub.uni-muenchen.de

Farsio, F., & Quade, S. (2003)., An empirical analysis of the relationship between GDP and unemployment. Humanomics, *19*(3), 1-6.

Furceri D., (2012)., Unemployment and labor market issues in Algeria, IMF Working, https://www.imf.org/external/pubs/ft/wp/2012/wp1299.pdf.

Knotek E., (2007). How useful is Okun's law. Economic Review, Federal Reserve Bank of Kansas City, 4: PP. 73-103.

Lancaster D., Tulip P., (2015). Okun's Law and Potential Output, Research Discussion Paper, Reserve Bank of Australia.

Moosa, I.A. (2008). Economic Growth and Unemployment in Arab Countries: Is Okun's Law Valid?, Journal of Development and Economic Policies, Vol.10, No.2, pp. 5-24.*

Okun, A.M. (1962)., Potential GNP: Its Measurement and Significance‖ American Statistical Association, Proceedings of the Business and Economic Statistics Section, 98-104.

Oluyomi Ola-David (2016)., Output and Unemployment Relationship: How Applicable Is the Okun's Law to Nigeria?, https://www.researchgate.net/publication/306396377.

Pesaran, M. H., Shin, Y. and Smith, R. J.,(2001)., Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics, Vol. 16 (3), pp. 289-326.

Pesaran and Shin, (1999). An autoregressive distributed lag modeling approach to co-integration analysis, s.l.: DAE Working papers, No. 9514.

Pesaran M. H., Pesaran B., (1997). Working with Microfit 4.0: Interactive Econometric Analysis, Oxford University Press, Oxford.

Pesaran M. H., Shin Y., (1995). Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis, DAE Working Paper Series No. 9514 (Cambridge: Department of Applied Economics, University of Cambridge).

Virén, M. (2001) ., The Okun Curve is Non-Linear‖ Economics Letters 70, 253-57.

Zanin L., Marra G, (2012)., A comparative study of the use of generalized additive model and generalized linear models in tourism research, Int J Tour Res 14:451–468.