



# Okun's law revisited – Empirical Evidence for the period 1999-2023

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<sup>1</sup> The views expressed herein are those of the authors and do not necessarily reflect the views of the Ministry of Finance or the Government of the Republic of Cyprus.

*Abstract*

Okun's law is a statistical relationship between the rate of output growth and the unemployment rate which asserts that changes in a country's Gross Domestic Product (GDP) and changes in the unemployment rate are inversely correlated. This essay corroborates the results of Mallis (2019) for Cyprus, while it investigates asymmetric correlations over gender and business cycles.

It is found that the unemployment rate for women is less responsive to shifts in output than it is for men, highlighting the disparities in the careers that men and women select. Moreover, unemployment is more responsive to changes in output during recessions, confirming the asymmetric correlation between unemployment and growth.

Keywords: Unemployment rate, Okun's law, GDP growth, economic cycle

E01, E24, J01, J21

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## 1. Introduction

Okun's law is an empirically observed relationship between the unemployment and output growth rates. It was originally proposed by Arthur M. Okun (1962). It provides a rationale for understanding the relationship between unemployment and the overall soundness of an economy. It posits that there is an inverse relationship between changes in the unemployment rate and changes in a country's Gross Domestic Product (GDP). In other words, when an economy is growing strongly and GDP is rising, unemployment tends to decrease. Conversely, during economic downturns and GDP contractions, unemployment typically increases. This reasoning is based on the natural dynamics of labor market, which show that when economies grow, businesses often hire more people to absorb increased demand, which lowers the unemployment rate. On the other hand, businesses cut back on staff during times of economic contraction, which raises the unemployment rate.

Okun's Law highlights the inherent trade-off between economic growth and employment levels, illustrating the critical role of economic policies and government interventions in stabilizing and fostering a healthy labor market within a country's economy. This principle continues to guide policymakers and economists in their efforts to analyze and address the complex dynamics of employment and economic growth. However, it should not be considered as a causal relationship but rather as a rule of thumb, since it is an empirical observation.

Usually, it is expressed as a negative linear relationship between the unemployment gap<sup>2</sup> (difference between the actual and natural unemployment rates) and the output gap (the difference between the log level of real output and log of the potential output):

$$u_t - u_t^* = \mu + \beta(\ln(y_t) - \ln(y_t^*)) + e$$

Where  $u_t$  is the unemployment rate at time  $t$ ,  $u_t^*$  the natural rate of unemployment (or the non-accelerating inflation rate unemployment),  $y_t$  the real output and  $y_t^*$  the potential output. The natural rate of unemployment and the potential output are not observed and should be estimated<sup>3</sup>.

Another specification of Okun's Law is the difference model, which has the advantage that it does not require an estimate of the potential output and the natural rate of unemployment. However, it assumes that potential output and natural rate of unemployment are constant over time. The difference model takes the form

$$\Delta u_t = \alpha + \beta \Delta \ln y_t + e$$

Where  $\Delta \ln y_t$  can be approximated by GDP growth rate. Thus, the model it can be estimated as:

$$\Delta u_t = \alpha + \beta g_t + e$$

Where  $g_t$  is the GDP growth rate. The coefficient  $\beta$  is known as the Okun's coefficient while the ratio  $-\frac{\alpha}{\beta}$  represents the rate of output growth consistent with a stable unemployment rate.

In the original paper, Okun found that a 2% increase in output is associated with 1% decline in the rate of short run unemployment. Moreover, Okun calculated, that a three-percentage

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<sup>2</sup> The cyclical component of the unemployment rate.

<sup>3</sup> Some methods of estimation are HP filter, unobserved components methods and others.

point rise in GDP from its long-run level would be accompanied by a 0.5 percentage point rise in the labor force participation rate, a 0.5 percentage point rise in the number of hours worked by each employee, and a one percentage point rise in labor productivity (output per worker per hour).

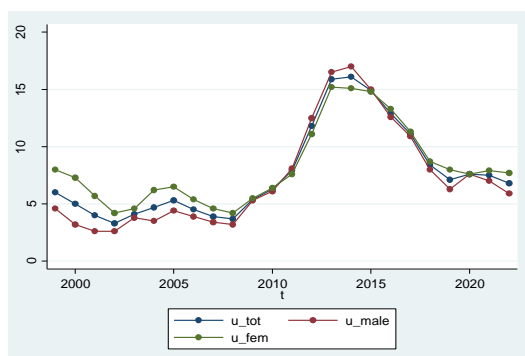
Several studies suggest the non-linearity of Okun's law. Ball et al. (2016) investigate Okun's law in developed vs developing countries. They found a stronger correlation between unemployment and output in developed than in developing countries (average Okun's coefficient has a value of -0.2 for developing countries and -0.4 for developed ones). Mussida and Zanin (2023) examine Okun's law in nine European countries from 1981 to 2021. They observe certain disparities in the patterns among nations, which are indicative of variations in labor markets and efficient systems. Farole et al. (2017) and Bartolucci et al. (2018) find that, in absolute values, Okun's coefficient is higher in rich economies. Other studies suggest asymmetries during recession and expansion periods (Holmes and Silverstone (2006), Bod'a and Považanová (2021), Lim et al., (2021), Mussida and Zanin (2023), Woo, 2023), over time (Huang and Lin (2008) and Karlsson and Österholm (2020)) and by the age and gender (Zanin (2014,2018)).

## 2. Stylized facts/ Graphs of unemployment rate and GDP growth

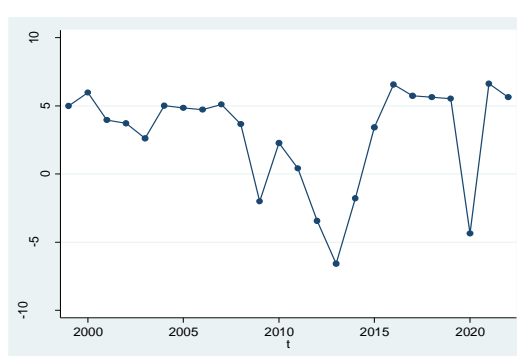
The great financial crisis that started in the summer of 2007 and developed into an international crisis in the fall of 2008, led to a deep global economic recession that affected all the economies around the globe, including the Cypriot economy. During 2009, the economy shrank by 2%, and unemployment which was 3,7% in 2008 rose to 5,4% in 2009, while it gradually increased reaching a peak of 16,1% in 2014 (**Figure 1**).

Subsequently, a series of factors led to the severe crisis of 2012-2013. In 2010 – 2011, economic growth was impotent and failed to reach the pre-2009 levels. After consecutive negative assessments by all international rating agencies, Cyprus lost market access in 2011. The main reasons were increase of non-performing loans, growing budget deficits, and exposure of Cypriot banks to Greek Government Bonds, which led to large lending losses.

Moreover, economic crisis was driven by several economic imbalances such as low competitiveness, significant increase of government expenditure, extraordinary enlargement of the banking sector. During 2012 – 2014, Cyprus economy entered recession with negative growth rates of -3,4%, -6,6% and -1,8% respectively (**Figure 2**). The recession of the economy was accompanied by a significant increase of unemployment until 2014 as depicted in **Figure 1**.



**Figure 1:** Annual Unemployment rate  
Source: Cystat.



**Figure 2:** Annual GDP Growth. Source: Cystat.

Following the bail-in and the macroeconomic adjustment programme (MoU), Cyprus in March 2016 exited the Programme and returned to a positive growth trajectory until the pandemic, while the unemployment rate was decreasing steadily. Although Cyprus entered 2020 under a sound position, the economy was highly affected by the Covid-19 pandemic due to its dependence on tourism and its high public and private debt levels. Cyprus economy contracted (GDP growth rate reached -4,4%) and unemployment rose to 7,6% as compared to 2019 (7,1%). Economy recovered fast during 2021 while unemployment rate remained at the same levels (7,5%). Following Russia's invasion in Ukraine, the Cyprus economy slowdown to 5,6% in 2022 while the unemployment rate reduced further (6,8%).

### 3. Brief description of the findings of the previous essay

Mallis (2019) examined the empirical relationship of unemployment and GDP growth in Cyprus using annual and quarterly data from Labor Force Survey and Eurostat for the period 1999-2018. During this period, a series of economic events such as the stock exchange bubble of 1999-2000, the 2002 tax reform, the EU accession in 2004, the 2006-2007 construction boom, the adoption of Euro in 2008, the 2012-2014 financial turmoil and the significant economic recovery in 2016-2018, took place. The results of the aforementioned paper indicate that 1 percentage point increase of the GDP growth rate (using either annually or quarterly data) is associated with a reduce of unemployment rate by 0.41 percentage points. In order to account for the delayed responses in the unemployment – output relationship (capturing the idea that employers need time to adjust employment when output changes), models including lagged values of GDP growth were estimated. The summation of the Okun's coefficient at  $t$  plus the Okun coefficient at  $t - 1$  equals -0.39 validating the results investigated above. Lastly, the author investigates the existence of asymmetries on Okun's Law in periods of expansions and contractions, considering the crisis years (2011q3-2014q3). It is found that in expansions unemployment decreases rather slow while in contractions unemployment increases rather fast.

### 4. Data

Data for unemployment are drawn from Labor Force Survey (Cystat). Labor Force Survey is conducted quarterly on a continuous basis. Annual rates for the years 1999-2003 refer to the 2nd quarter of the year, while for the remaining years the average of the year is presented. In annual data, the sample consists of 23 observations covering the period 1999-2022. Quarterly data ranges from the second quarter of 2004 to the third quarter of 2023. Moreover, data for GDP growth rate at constant prices (2010 base year) is obtained from Cystat. Quarterly GDP growth rates compared with the same quarter of the previous year are used.

We estimate the difference model for total unemployment, males' unemployment and females' unemployment for both annual and quarterly data.

### 5. Results

Table 1 (**Appendix**) summarizes the OLS regression results of the Difference of Unemployment rate (Total, Males' and Females') on GDP growth rate (Columns 1, 2 and 3 respectively) in annual terms for the period 1999 – 2022. Results validate the negative statistically significant correlation between unemployment and GDP growth, with Okun coefficients ranging from -0.351 for total unemployment, -0.411 for males' unemployment and -0.289 for females' unemployment. Furthermore, the women's Okun coefficient is lower than men's, indicating that women's unemployment is less responsive in output changes,







## APPENDIX

### Figures

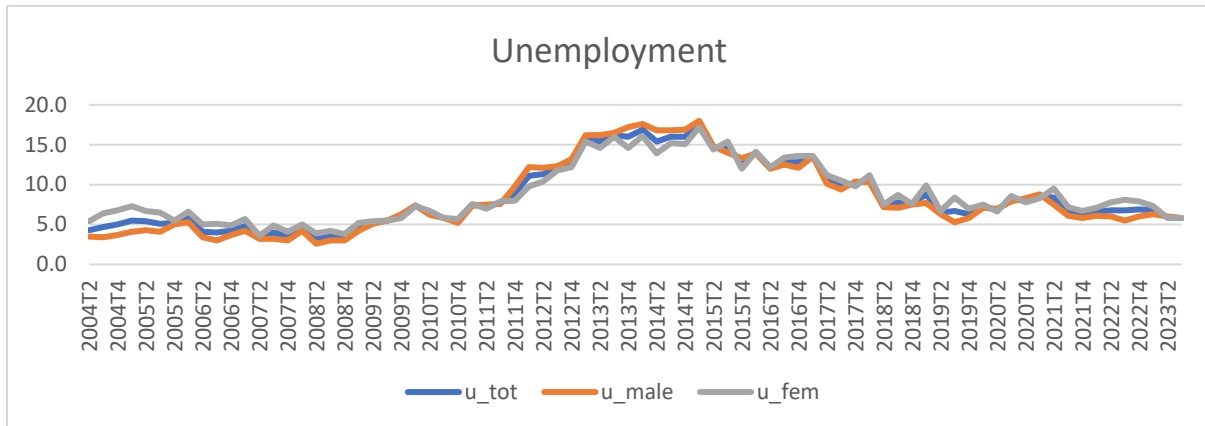


Figure A1: Unemployment Rate. Source: Cystat.

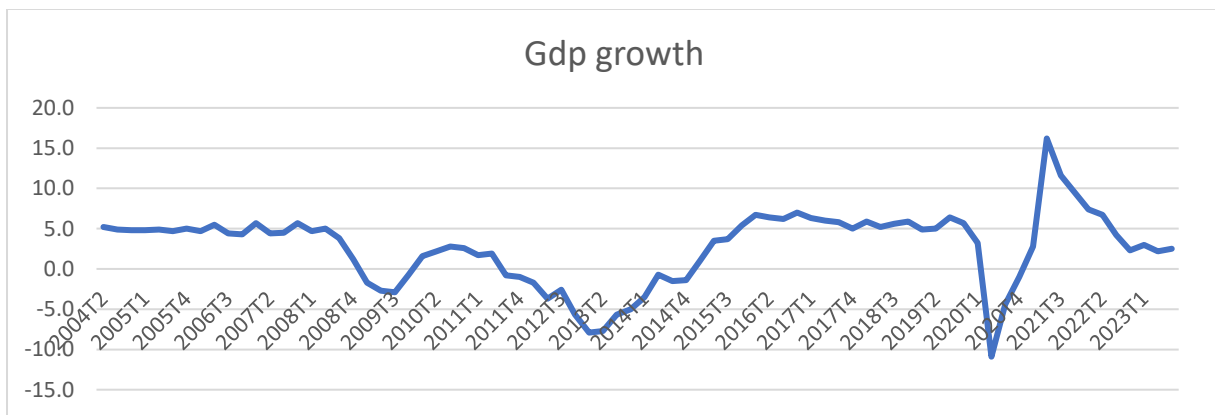


Figure A2: GDP Growth Rate, Quarterly Data. Source: Cystat.

## Tables

	(1)	(2)	(3)
VARIABLES	Total	Males	Females
gdp growth	-0.351*** (0.0727)	-0.411*** (0.0643)	-0.289*** (0.0888)
Constant	0.999*** (0.339)	1.187*** (0.314)	0.781* (0.403)
Observations	23	23	23
R-squared	0.641	0.704	0.469

Table 1: Annual data for the period 1999 – 2022

	(1)	(2)	(3)
VARIABLES	Total	Males	Females
gdp growth	-0.432*** (0.0563)	-0.474*** (0.0626)	-0.389*** (0.0622)
Constant	1.250*** (0.269)	1.398*** (0.302)	1.077*** (0.284)
Observations	20	20	20
R-squared	0.757	0.754	0.659

Table 2: Annual data for the period 1999 – 2019

	(1)	(2)	(3)
VARIABLES	Total	Males	Females
gdp growth	-0.302***	-0.350***	-0.251***
	(0.0682)	(0.0662)	(0.0751)
2.quarter	0.0455	0.0483	0.0489
	(0.555)	(0.586)	(0.585)
3.quarter	0.00172	0.0227	-0.0182
	(0.425)	(0.486)	(0.448)
4.quarter	0.0333	0.00556	0.0611
	(0.451)	(0.533)	(0.464)
Constant	0.823**	0.994**	0.624
	(0.371)	(0.421)	(0.381)
Observations	74	74	74
R-squared	0.478	0.517	0.347
Robust standard errors in parentheses			
*** p<0.01, ** p<0.05, * p<0.1			

Table 3: Quarterly data for the period 2004q2 – 2023q3

	(1)	(2)	(3)
VARIABLES	Total	Males	Females
gdp growth	-0.449***	-0.484***	-0.414***
	(0.0352)	(0.0416)	(0.0407)
2.quarter	0.0537	0.0835	0.0326
	(0.460)	(0.553)	(0.436)
3.quarter	0.0164	-0.00232	0.0572
	(0.459)	(0.570)	(0.415)
4.quarter	-0.0422	-0.00189	-0.0738
	(0.496)	(0.621)	(0.469)
Constant	1.146***	1.239**	1.025***
	(0.377)	(0.485)	(0.315)
Observations	59	59	59
R-squared	0.708	0.668	0.658
Robust standard errors in parentheses			
*** p<0.01, ** p<0.05, * p<0.1			

Table 4: Quarterly data for the period 2004q2 – 2019q4

Quarterly data	Total	Males	Females
Period 2004q2 – 2023q1	2.73	2.84	2.49
Period 2004q2 – 2019q4	2.55	2.56	2.48

Table 5: Rates of output growth consistent with a stable unemployment rate

	(1)	(2)	(3)
VARIABLES	Total	Males	Females
gdp growth	-0.108	-0.147*	-0.0666
	(0.0927)	(0.0800)	(0.113)
gdp growth (t-1)	-0.239***	-0.251***	-0.227**
	(0.0887)	(0.0788)	(0.106)
2.quarter	0.0531	0.0563	0.0561
	(0.442)	(0.485)	(0.473)
3.quarter	0.0179	0.0398	-0.00277
	(0.443)	(0.495)	(0.474)
4.quarter	0.0466	0.0195	0.0737
	(0.438)	(0.512)	(0.467)
Constant	0.936***	1.114***	0.732**
	(0.334)	(0.389)	(0.346)
Observations	74	74	74
R-squared	0.582	0.609	0.446
Robust standard errors in parentheses			
*** p<0.01, ** p<0.05, * p<0.1			

Table 6: Quarterly data for the period 2004q2 – 2023q3, with lagged gdp growth.

	(1)	(2)	(3)
VARIABLES	Total	Males	Females
crisis	0.983	1.395	0.525
	(0.823)	(0.991)	(0.739)
gdp growth	-0.184**	-0.256***	-0.104
	(0.0812)	(0.0868)	(0.0802)
crisis*gdp growth	-0.267*	-0.0774	-0.486***
	(0.144)	(0.171)	(0.140)
2.quarter	0.0653	0.0571	0.0815
	(0.501)	(0.547)	(0.504)
3.quarter	-0.00223	-0.0303	0.0336
	(0.421)	(0.498)	(0.410)
4.quarter	-0.0213	-0.0720	0.0319
	(0.465)	(0.545)	(0.461)
Constant	0.171	0.471	-0.182
	(0.458)	(0.515)	(0.432)
Observations	74	74	74
R-squared	0.565	0.565	0.497
Robust standard errors in parentheses			
*** p<0.01, ** p<0.05, * p<0.1			

Table 7: Quarterly data static model for the period 2004q2 – 2023q3, accounting for the crisis.

