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Unemployment and Economic Growth: A Cross-Sectionally Autoregressive Distributed Lag (SC-ARDL) and Dynamic Common Correlated Effects (DCCE Panel) for North African Countries

ABSTRACT

This paper is aimed at examining the relevance of the dynamics relationship between unemployment and economic growth in North African countries from 2006 to 2022. The study adopted Panel ARDL model and Dumitrescu-Hurlin panel Granger causality analysis that allows capturing slope heterogeneity among each member. The results obtained from the cointegration technique of (Pesaran & Shin, 1999) confirm that a long-term relationship exists between growth and unemployment rate. The purpose of this study is to investigate the relationship between economic growth and unemployment in North African countries for the period of 2006–2022 within panel data framework by applying cs-ARDL and common correlated effects in a *dynamic* panel (DCCE).

In this paper this relationship has been examined in the context of Okun's Law. Panel Unit Root with 2nd generation and Westerlund cointegration test were applied, respectively. The results show that the economic growth and unemployment series are stationary at first difference, unemployment was affected positively by economic growth, in other words 1% rise in GDP will decrease the unemployment rate by 0.05% because of Okun's coefficient for North African countries and there is a co-integration between these important macroeconomic variables.

KEYWORDS: North African countries; unemployment rate; economic growth; CSARDL; DCEE.

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INTRODUCTION

The empirical modelling of wages on time series is the first step that we have chosen to model the relationship between growth and unemployment in the five countries that form North Africa (Algeria, Egypt, Morocco, Libya, Tunisia). The latter is also a first step in the macroeconomic modelling of Moroccan economy. In this work, we propose an estimate for the countries of North Africa of the market wage rate from 2006 to 2022; such modelling of the unemployment rate is based on two alternative specifications: Okun's Law explaining the growth rate and the unemployment rate linking the levels of wages and prices to the unemployment rate.

The choice of a level or growth rate specification is not without consequences. Indeed, this choice will determine the equilibrium unemployment rate of the model. The degree of integration of the variables taken into account in the modelling is of major importance in the choice of a specification. A study of the stationarity of the different variables used is very important.

We first estimate this relationship between all variables in annual panel data covering the period from 2006 to 2020, the estimation method used is a Panel-ARDL allowing consideration of both the short and the long term. The growth rate specification Okun's law generally corresponds to the short term, while the level specification corresponds more to the long term. A treatment of the non-stationarity of the variables studied will be very useful.

Okun's law

Okun (1962), in his study of the US economy, empirically proved an inverse relationship between unemployment rate and the potential output, depending on the participation in the workforce, the duration of work and the change in productivity (Holmes & Silverstone, 2006).

The theoretical basis of the relations Okun investigated is based on the fact that the increased workforce must produce more goods and services. He found that the unemployment rate declined in the years when the real growth rate was high, whereas unemployment rate increased in the years when the real growth rate remained low or even negative.

Unemployment rate

Unemployment rate is generally defined as the ratio between the number of unemployed individuals who are actively seeking work – or those who are temporarily laid off – and the total number of employed and unemployed.

Unemployment or its high level is one of the characteristics of poor or developing countries. It is also one of the major concerns of public authorities in all countries.

As shown in Figure 1, since 2006, the average unemployment rate in these countries has steadily increased, rising from 9% in 2006 to 14% in 2019–2020 like Tunisia , dropping to 12% in 2006 and rising to about 19% in 2020 (Libya).

In North Africa, unemployment is a serious problem. It's often overwhelming when people lose their jobs and can't find another one, or when graduates just can't get one. It represents one of the essential reasons that explain specially by COVID-19 and its impact and certain social phenomena such as illegal emigration, banditry, corruption, terrorism, etc.

Economic growth

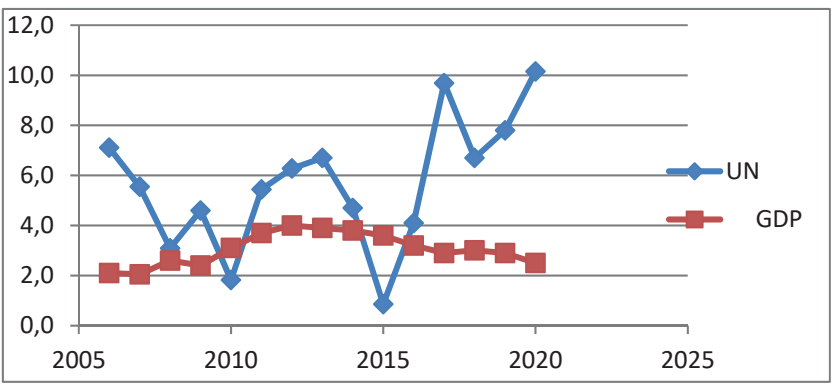
Data collected from the statistics directorate of North African countries show a downward trend from 2006 to 2020, then an unstable trend since 2020 due to COVID-19 all over the world.

It can be shown that the growth rate varied from 4.5% in 2006 to 5.2% in 2020 (e.g., Algeria). However, this evolution of economic growth in Egypt went through peaks in 2006 (4.13%) and in 2007 (3.62%). Either way, there is a general downward trend.

This decrease is explained by the fact that the authorities of these countries have closed a lot of businesses. The question that now arises is whether this policy is really a success. It is indeed necessary to understand the measures taken by the government to achieve this objective.

The measures applied in the fight against inflation are often restrictive and can indirectly cause other problems such as slowed growth. This was the case in Morocco and Tunisia in 2006–2010 and 2013–2020.

Figure 1. Unemployment and economic growth in North African countries.



Note. Based on World Bank data.

Finally, consider the impact of growth on the unemployment rate. It is clear that these measures did not have negative effects in the short term. Not only this, but also in the medium term, when we observe the development of these two rates, from 2006 to 2020. Indeed, the growth rate fell from 10.13% in 2006 to – 3.2% in 2020 (Morocco) while the unemployment rate followed an opposite trend, going from 8.5% on average (10.8% in urban areas) in 2006 to around 13% (19.5% in urban areas) in 2020 (Tunisia).

A theoretical study and modelling of the growth rate and the equilibrium unemployment rate are necessary to better understand this phenomenon.

Main previous findings

Several studies deal with the relationship between unemployment and economic growth according to Okun's law.

In Zimbabwe, Saungweme and Odhiambo (2019) investigated the relationship between economic growth, formal employment, gross fixed formation and money supply. Formal employment was used as a dependent variable while economic growth, gross fixed formation and money supply were independent variables. The study employed the ARDL approach and found that economic growth and gross capital formation positively influence formal employment. Therefore, an increase in economic growth in Zimbabwe creates more jobs while the buying of machinery in Zimbabwe expands production capacity that translates into formal job creation. The same results were obtained by Bande-Ramudo et al. (2014), though they used a structural VAR model. Contrary results were found by Suleiman et al. (2017) in Tanzania. The authors employed the dynamic ordinary least square (DOLS) methodology and concluded that economic growth and gross domestic formation are negatively related to employment in Tanzania. In other words, as economic growth and gross domestic formation increases, employment falls. This was possibly due to the increase in investment, which is attributed to large capital formation, a close substitute of labour according to the classical production function, which states that [Q = f(L,K)]. Therefore, output is a function of labour and capital. Sahnoun and Abdennadher (2019) adopted a different stance by comparing developed and developing countries. The authors examined the relationship between unemployment and economic growth and looked at other variables such as government size, trade and inflation. The study used panel data and found that inflation, trade and

economic growth are negatively related to unemployment in both developed and developing countries. The results imply that low inflation rate, an increase in trade activities and economic growth increases the chances of employing one individual in both developing and developed countries. In the same vein, a study in emerging countries has shown that gross domestic formation reduces the unemployment rate Bayar (2016). The study used panel data between 2001 and 2014.

This study investigates the interaction among unemployment, financial development and domestic investment in 16 emerging market economies in 2001–2014 using panel data analysis. He found that there was a long relationship among the variables and domestic investment had a negative impact on unemployment. Aaronson et al. (2010) analysed the factors that have generated the increase of long-term unemployment and the implication for future economic evolution. Michaillat (2012) is preoccupied with the role of matching frictions in influencing and thus explaining unemployment; he proposes a search-and-matching mode. Daly et al. (2012) elaborate on a similar topic, and their results underscore the critical role of self-control in shaping life-span trajectories of occupational success and affecting how macroeconomic conditions impact unemployment levels in the population. Lalive (2007) provides evidence on the relationship between unemployment benefits unemployment duration, based on the idea that benefits tend to lead to the growth of unemployment duration, his study pursues the Austrian system, while Le Barbanchon (2016) studies, on a similar approach, the French case. Shimer and Werning (2007) have tested the optimal character of unemployment insurance based on the responsiveness of reservation wages to unemployment benefits. Nekoei and Weber (2017) discuss the potential positive impact of unemployment benefits on job quality.

Other studies have empirically investigated the relationship between unemployment and economic growth in Nigeria using different analytical technique. For example, Ademola and Badiru

(2016) in a recent study investigate and determine the effects of unemployment and inflation on economic performance in Nigeria between 1981 to 2014. Ordinary Least Square (OLS) technique was adopted with various diagnostic test to determine how fit the data are for the analysis. The result indicated that unemployment and inflation are positively related to economic growth. The positive relationship between unemployment, inflation and Real Gross Domestic Product (RGDP) indicates that in Nigeria is driven by oil revenue that employs very limited highly skilled labour, and the price of output of crude oil is determined externally which may not response as expected to growth of output in the country.

Amid the rising growth rate and increase in output in Nigeria, Soylu et al. (2017) applied Panel Unit Root, Pooled Panel OLS and Panel Johansen Co-integration test to examine the relationship between economic progress and unemployment in Eastern European Countries for the period of 1992–2014 within panel data framework. The findings of the studies revealed that unemployment and economic growths were stationary at first level. However, the results of studies also revealed the presence of an adverse long-term cointegration between unemployment and economic progress. More so, economic progress positively causes a change in unemployment which means an upsurge in economic progress will eventually lead to a drop in unemployment, also Lozanoska and Dzambaska (2014) examined the relationship between economic growth and unemployment for the Macedonian economy.

Phiri (2014) study for the countries of South Africa covering the period of 2000–2013, revealed nonlinear equilibrium between economic growth and unemployment. To do this, a momentum threshold autoregressive model was used. Makun and Azu (2015) analyzed the relationship between economic growth and unemployment for the Fiji economy over the years 1982–2012. A long-term relationship between economic growth and unemployment has been identified as a result of the analysis. Ruxandra

(2015) examined the relationship between economic growth and unemployment for the post-2007 period. It has been determined that Okun's law is valid for the Romanian economy.

Apart from investigating the existence of the relationship between output level and unemployment rate, another discussion in the literature concerns whether there is an asymmetry in relation to output unemployment.

Banda et al. (2016) also analysed the effect of economic development on unemployment of South Africa by employing a periodical time series data for the period of 1994–2012. Their studies showed the existence of a positive long-run relationship between unemployment and economic development after using Johnsons' Cointegration and Vector Error Correction Model. This means an increase in unemployment in the long term, which will also reflect economic growth.

Rahman (2013) studied the relationship through GDP, GDP per capita, literacy rate, and the unemployment rate in OECD countries. He found GDP not significantly related to GDP per capita, literacy rate or unemployment rate. Khrais and Al-Wadi (2016) studied the linkage between economic growth and unemployment in Middle East North Africa countries (MENA)[1] in the period of 1990 to 2016, using simple linear regression, and found a weak linkage among the mentioned variables. Additionally, Soylu et al. (2018) examined the linkage between unemployment and economic growth based on Okun's law (which reflects the linkage among the unemployment and economic growth) in Eastern European Countries from 1992 to 2014 and found cointegration among the unemployment and GDP growth (negative relation-

[1] The Middle East and North Africa (MENA) Section in the Field Operations and Technical Cooperation Division (FOTCD) is based at OHCHR headquarters in Geneva and covers 19 countries: Algeria, Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Occupied Palestinian Territory, Qatar, Saudi Arabia, Syria, Tunisia, United Arab Emirates, and Yemen.

ship). We can add a study of Nagel (2015), who discussed the nexus of GDP growth and unemployment and found a negative correlation between economic growth and unemployment. Besides, Ahmed et al. (2013) examined the relationship between the unemployment rate and growth rate in selected SAARC countries (Bangladesh, Bhutan, India, Pakistan, and Sri Lanka) throughout 1990–2010, using OLS and found a sign of the correlation among the economic growth rate and unemployment rate vary between the SAARC countries.

METHOD

Data

This study uses data on current unemployment and economic growth from the world bank for Algeria, Morocco, Tunisia, Libya, and Egypt. We therefore had a balanced panel data for five North African countries, all data sets are taken as percentage of the GDP for the time period from 2006 to 2022.

Tests

Panel cross-section dependence test

We may test for cross-section dependence in a series in a panel structured work file. There are a variety of tests for cross-section dependence in the literature, and Eviews software offers the following tests: Breusch–Pagan LM, Pesaran scaled LM, Baltagi, Feng, and Kao bias-corrected scaled LM, Pesaran CD.

The estimation outputs for panel cross-section dependence are shown in Table 1. Based on the fact that the number of cross-sections in our panel were less than time series (large T and small N), the Lagrange Multiplier test statistic became the most reliable and valid test statistic. As shown, the LM test statistic is 4.435 with

a probability value of 0.365. At 5% significance level, we failed to reject the null hypothesis of cross-sectional independence.

Table 1. Cross-sectional dependence test results.

Variable	Breusch–Pagan LM	Pesaran scaled LM	Baltagi, Feng, and Kao	Pesaran CD
UN	4.244 (0.216)	2.618 (0.1 24)	4.435 (0.365)	3.141 (0.184)
GDP	2.028 (0.142)	3.887 (0412)	2.705 (0.229)	2.705 (0.229)

According to the results of the four tests, it is clear that the variables do not suffer from cross-sectional dependence; thus, the alternative hypotheses of cross-sectional dependence are rejected, i.e., the shocks in one sample do not affect other countries in terms of all variables.

Homogeneity test

To verify this condition, we will opt for two complementary tests. The first is the Swamy (1970) test, which considers the dispersion of individual slope estimates from an appropriate pooled estimator as the basis for slope homogeneity. The second is the Pesaran and Yamagata (2008) test, which compares the weighted difference between the unit-specific cross-sectional estimate and a weighted pooled estimate. The results of the two tests are presented in Table 2.

Table 2. Slope heterogenous test.

Swamy test:	Pesaran and Yamagata test:
$\chi^2 = 67.342$ (0.000)	$\Delta = 12.331$ (0.000) Δ (adj) = 26.553 (0.000)

The Probability of Chi-square test by Swamy (1970) is significant at 1% in addition to the probability of the Pesaran and Yamagata test (2008), which is significant at 1%. So we can ensure the rejection of the null hypothesis and the confirmation of the heterogeneity of the data-generating process (there was heterogeneity of slope).

Panel unit root test

We have chosen in this section the second generation cross-sectional dependencies that are based on factor structure, such as Bai and Ng (2001, 2002, 2004), Moon and Perron (2004), Phillips and Sul (2003), Im et al. (2003), Choi (2001), Levin and Lin (1992).

Table 3. Unit root test results (2nd generation tests).

PES-CADF					
Variable	Const.	Const. and trend	Variable	Const.	Const. and trend
GDP	–1.276	0.366	**Δ GDP**	–13. 227*	–12. 563*
UN	–0.759	0.784	**Δ UN**	–11. 998*	–11. 883*
CIPS					
Variable	Const.	Const. and trend	Variable	Const.	Const. and trend
GDP	–1.687	–2.665	**Δ GDP**	–5.286	–4.891
UN	–1.084	–2.019	**Δ UN**	–5.447	–4.138

Note. H_0 = the homogeneous is non-stationary, from general to particular, based on F joint test; critical values; CIPS with constant = 10% (–2.03), 5% (–2.11), 1% (–2.25); critical values CIPS with constant and trend = 10% (–2.54), 5% (2.62), 1% (–2.76).

* Significant at 1%.

Table 3 presents the results of the unit root test under the hypothesis of dependence between members of the panel. It appears that all variables are stationary at first difference in the model with individual constancy, while in the model with in-

dividual constant and trend, it fails to reject the null hypothesis of no cointegration between variables for all the statistics (Levin et al., 2002). Regardless of the specification of the deterministic component considered, we can conclude that there is a long-term equilibrium relationship between the variables when we consider cross-dependence in the panel.

Cointegration panel test

After confirming the absence of cross-sectional dependence and the *I*(1) series obtained from unit root tests, we proceeded with the co-integration tests.

According to Westerlund's cointegration test (2007) for the existence of a long-run relationship between variables, all test statistics reject the null hypothesis of no cointegration at the 5% level. Results suggest that cointegration exists and the series are expected to move together in the long-run.

Table 4. Westerlund's cointegration test results.

Test	Statistic	Z-value	*p* value	**Robust *p* value**
G_t	−4.557	−5.668	0.047	0.056
G_t	−1.182	−8.217	0.039	0.038
P_t	−5.466	−7.908	0.038	0.016
P_a	−7.338	−9.548	0.014	0.024

Note. H_0 = no cointegration; lags and lead automatically selected by AIC criterion with Bartlett–Kernel window width set according to $4(T/100)^{2/9} \approx 3$; robust *p*-value controls for cross-section dependence.

Panel cointegration modelling

The traditional methods such as mean group (MG), augmented mean group (AMG), pooled mean group (PMG), dynamic fixed effect (DFE), fully modified ordinary least squires (FMOL), and

dynamic OLS (DOLS) may be provided weak outcomes due to CD (Chudik & Pesaran, 2015; Dogan et al., 2017). Therefore, we also applied the DCCE CS-ARDL technique to calculate the coefficients of the considered variables and to robust the PMG estimation. However, we find similar signs of the coefficients, although coefficients of the variables are different than PMG estimation.

When we examine the stationary levels of the variables, log_pro and log_inc are integrated I(1) and I(0), respectively. Furthermore, cross-sectional dependent variables necessitate the CS-ARDL approach.

Table 5. Common correlated effects estimator (CS-ARDL).

Long-term coefficients	Dep variable: UN		
		MG	SC-ARDL
CONST		2.149* (0.007)	0.477*** (0.000)
GDP		−3.216 (0.218)	3.223** (0.01)
ECT(−1)		−0.661*** (0.000)	−0.246*** (0.000)
Hausman test		–	1.386 (0.882)
Number of observations		75	75

Note. Own elaboration.

* Significant at 1%, ** significant at 5%, *** significant at 10%.

The results obtained with the DCCEMG technique, presented in Table 6, illustrate the robustness of the CS-ARDL method. The evaluated values of the parameters can vary in significance and weightiness, but the similar signs of the two techniques show the robustness of the process. Likewise, comparable movements in the post-estimated data further emphasize the efficiency and reliability of this study.

Table 6. Outcomes of the DCCEMG approach.

Variable coefficient		*SE*	*p*
GDP	**3.455**	*0.768*	***0.029***
UN	**–4.539**	*0.238*	***0.012***
GDP	3.455	0.768	0.029
UN	–4.539	0.238	0.012

Granger causality (Dumitrescu–Hurlin)

Table 7 Reports output for the Dumitrescu-Hurlin panel causality test. As shown, at both 5% and 10% levels of significance, the probability values are too large to justify the presence causal relationship between current unemployment and economic growth. This gives evidence that, the current study finds Okun's law hypothesis is valid in North African countries.

Table 7. Dumitrescu–Hurlin panel causality test.

Null Hypothesis	W-stat	Zbar-Stat	Prob
GD ↛ PUN	4.67	**0.87**	**0.033**
UN ↛ GDP	**2.55**	**0.091**	**0.06**
Legs	**1**	**1**	**1**

Note. "↛" is null hypothesis that is not a homogeneous cause. Significant values in bold.

CONCLUSION

The main target of this paper is to analyse the relationship between unemployment and growth according to Okun's law. In the study, unemployment and growth rates of the North African countries from 2006 to 2020 were analysed using the panel data method.

In this paper, a panel unit root test was applied and it is understood that the series are stationary. For this reason, the first differences of the series have been taken. After this phase, panel ARDL was tested and it was determined that 1% rise in GDP will lower the unemployment rate by 0.03%. Finally, our data sets were tested by using co-integration test and found that there is a co-integration between unemployment and growth. The estimates performed in the years 2006–2020 in different systems refer in particular to Okun's law and highlight the phenomenon of unemployment hysteresis in north African countries and in the eight countries studied for comparison. Indeed, we show that there exists a long-term relationship systematically linking the total unemployment rate to the rate of long-term unemployment. This being an explanatory factor of the hysteresis, any deviation from this relationship has a lasting impact on variations in the unemployment rate. We find therefore that long-term unemployment has a lasting causal impact on the level of total unemployment. Regarding the links between trend growth and unemployment, we observe a central role of long-term unemployment in the evolution of trend growth for all the countries studied. More specifically, after 2019 and in the case of Egypt, Morocco and Algeria, it was rather long-term unemployment that impacted growth, whereas the reverse causality was observed before the economic crisis. This inversion is an additional justification for the need to develop specific support actions for the long-term unemployed in the search for a job. We have indeed been able to show that the impact of long-term unemployment on the evolution of total unemployment and on trend growth can be explained in particular by behaviours of discouragement and withdrawal from the labour market. In the case of Egypt , we find that long-term unemployment has a persistent (unidirectional) causal impact on the labour force which in turn has a lasting influence on GDP growth. In the case of Morocco, the effects of discouragement induced by long-term unemployment are directly highlighted

since we have discouragement rates by age group. The results vary according to age group

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